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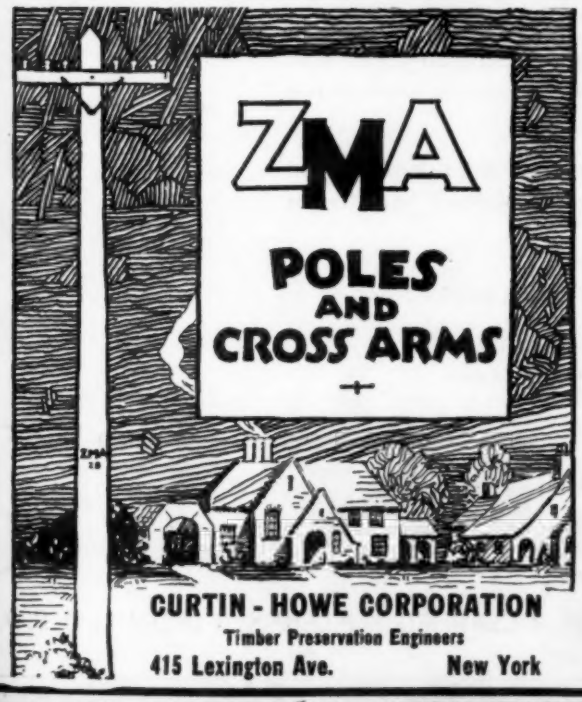

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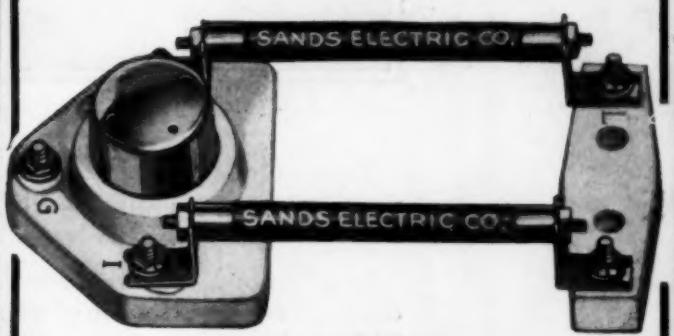

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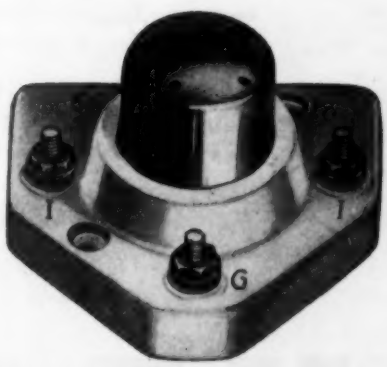

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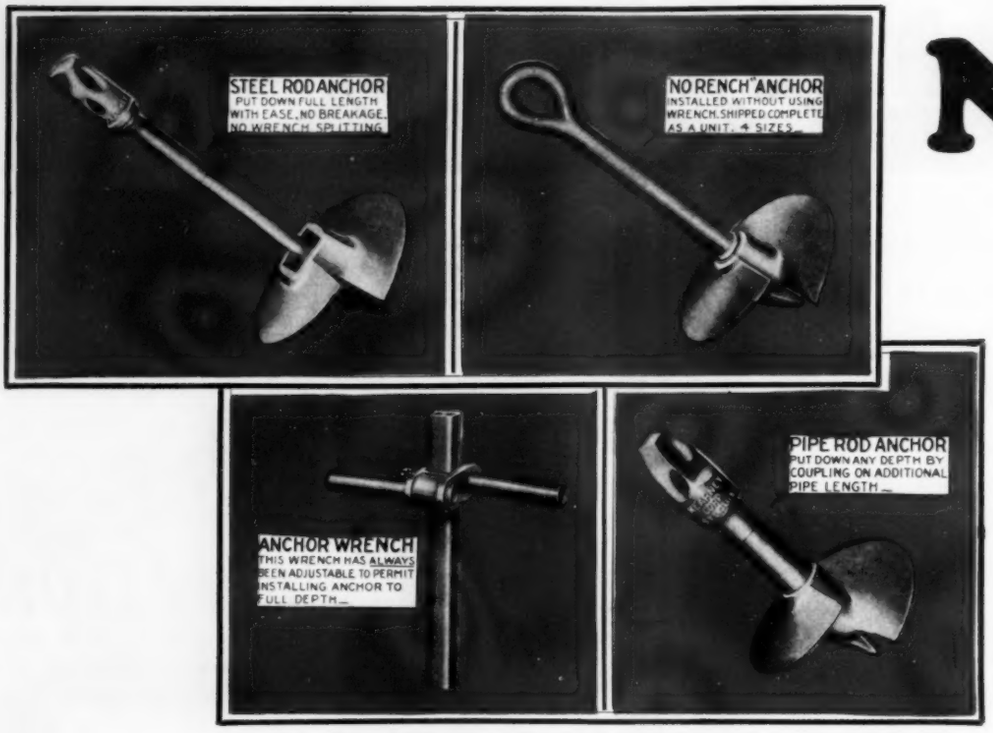
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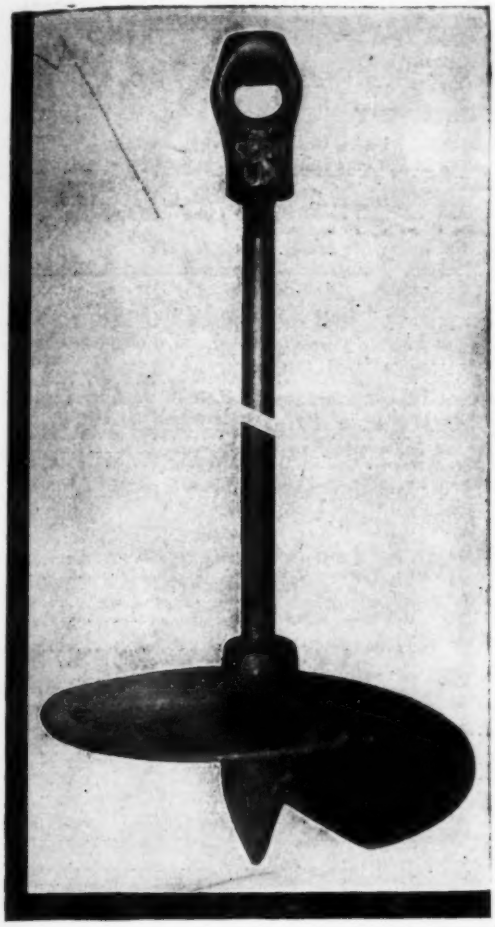

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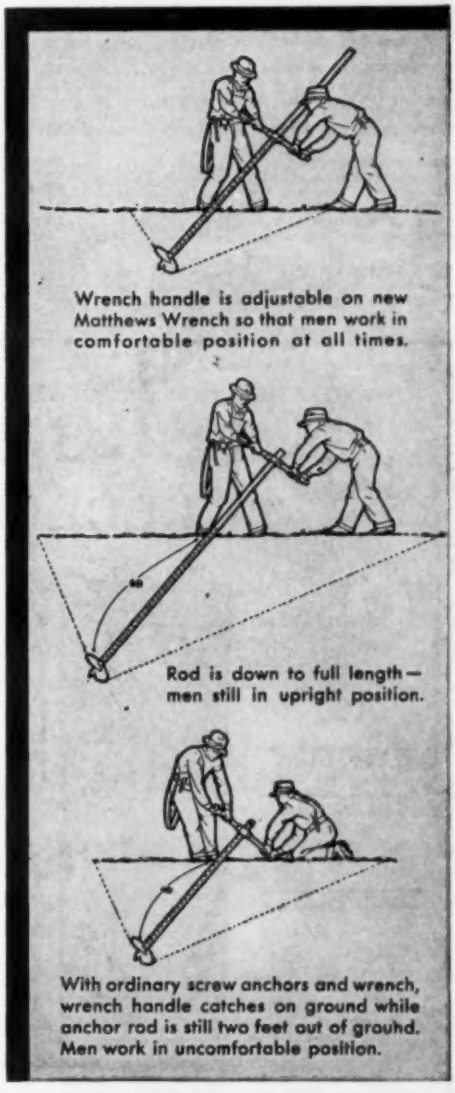

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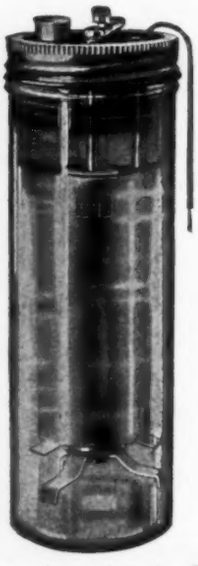

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Volume 34 MARCH, 1930 No. 3

The Communications Commission Bill

The testimony of the representatives of the telephone industry before the Senate Committee on Interstate Commerce has very definitely expressed the opinion of telephone men relative to regulation of the industry. It was brought out forcibly that only a very small percentage of the business of telephone companies measured either in number of calls or dollars of revenue is interstate in character; that the telephone business is essentially intra-state in character.

On account of its intra-state character, it has been recognized generally in the past that regulation except as it relates to the small percentage of interstate business, is a matter for state rather than federal attention. While the testimony of representatives of both groups of the industry agreed on this, it would seem that the opinions of representatives of the Independent group made more impression on the senatorial committee than those of the Bell group. Reports of the hearing indicate that it was a surprise to several of the committee to learn that there are several thousand telephone companies operating over four and a half million telephones which are entirely independent of the Bell system, both in operations and financial connections.

As to the interstate portion of the business, the testimony was uniformly in favor of continued supervision of the Interstate Commerce Commission rather than supervision by a communications commission which would be more than busy with radio problems. In the picturesque language of President MacKinnon of the Independent Association, "its members prefer to be hitched up with the railroad organizations than to be driven into the same corral with the kicking and biting herd that is known as the radio industry."

Reports do not yet indicate whether or not the bill is likely to be reported out of the committee or in what form it will be if it is reported out. The telephone industry has presented a convincing case for state regulation of the intra-state portion of its business and there has been no evidence of any importance presented to show the necessity of change in the present method of regulation of interstate telephone transmission. It is to be hoped that the absence of a showing of need for change in present methods of telephone regulation will prevent the inclusion of telephone companies in any bill which may be provided for radio and other forms of communication.

The Price of Copper

There has been much speculation in newspapers recently as to whether the price of copper metal can be maintained at the eighteen-cent figure that has been in effect for nearly a year. For the past few months the statistical position of the metal has become increasingly unfavorable to the maintenance of the price and yet the price has held steady.

Stocks of refined copper have been increasing up to the close of January, the last figures available as this is being written. This has occurred in spite of drastic reductions in operations by the various producers. This would indicate the possibility of a decrease in price to stimulate sales, but the producers seem to be confident that the spring demand will absorb production without the stimulating effect of a price cut.

There are many who think that the present price of copper has been set at an uneconomical figure and that while the producers may be able to get an artificially high price, they will not be able to profit by it because of reduced demand. We are not familiar enough with conditions in other copper consuming industries to form an accurate picture of the possibilities, but we are certain that this is taking place to some extent in the telephone business.

In the field of the open wire telephone subscriber line copper is in competition with iron wire and for several years was making headway. Recently, with improvements in iron wire manufacture and high price of copper, this is not the case. Some of the companies which a couple of years ago were using copper quite extensively in open wire subscriber

lines, have swung back to the use of iron wire.

In the long distance field, copper is no longer supreme. On the more important lines toll cable which depends in cost upon a number of factors beside the price of copper is taking the place of heavy open wire leads. There is no doubt that the extension of toll cable has been accelerated by the high price of copper and this will continue if the present price relations stand. The economic balance is now favorable to cable in some of the less congested lines where open wire might be economical if copper prices were lower.

Naturally, the telephone industry being a consumer of copper is interested in having the price as low as possible. However, it is recognized that the copper industry should have a fair profit on its operations in order to assure continued development. On the other hand, if copper continues at its present levels, telephone companies cannot be blamed if they reduce their copper purchases in order to take advantage of a more economical alternative material or method of construction.

A Cash Reserve for Smaller Companies

In general students of utility matters have argued against the creation of a cash reserve for depreciation of utility property, pointing out the greater economy of use of the reserve for investment in the company in the form of plant extensions which will earn at a rate greater than the usual sinking fund interest rate. We have noted an exception to the general opinion particularly in application to small companies, in editorials that have appeared from time to time in the Indiana Telephone Bulletin.

We are inclined to agree with our friend, Henry Barnhart, or whoever wrote the editorials at least in so far as they apply to a certain type of telephone company. To illustrate, we may cite the example of three small exchanges which lay in the path of a recent destructive sleet storm. In one of these, the exchange was abandoned because there was no money available to rebuild it. What was left of the plant was practically donated to a nearby company with the understanding that the nearby company would rebuild the lines and give service.

In another plant of the mutual type, a heavy assessment was levied on the stockholders to provide funds for rebuilding. In the third plant, the company having a nest egg of several hundred dollars in a cash reserve found, was enabled to begin rebuilding immediately with the fund as a start and with ample bank credit for the balance because it had placed its business on a sound foundation.

A very large number of the small plants of the country may be said to be operating on a non-profit basis. By this we mean that they are operated principally to furnish service to a community and the owners and stockholders are not depending upon the return from their investment for a living. Since the making of a maximum return on the investment under a given rate schedule is not the objective, the economic advantages of the reserve invested in property are not important. In such a case the creation of a cash reserve is not only a good business proposition, but is almost a necessity as insurance against a calamity like a sleet storm or fire.

The Bell Annual Report

Each year everyone who is interested in the telephone business looks forward to reading a report of achievement in the annual report to the stockholders of the American Telephone and Telegraph Company. The report for 1929, which has just been released, is no exception to the rule. It is a record of continued progress in the art of voice communication.

This progress is not measured alone in growth of subscriber stations, although the growth of the Bell System was about 900,000 telephones, the largest of any single year. Neither is it measured in growth of subscriber and toll revenue, although each of these showed a substantial increase over preceding years. Nor is it measured by growth of investment or by mere physical size, although new telephone plant amounted to over one-half billion of dollars and the total plant over four billion.

While all of these things are indications of progress, they would be meaningless unless there were real progress in extending and improving the value and use of the service to the millions of telephone users of the country and the world. As to extension of the service, we have had the range of possible telephonic communication extended to several additional nations of the old world as well as to ships in midocean and aircraft in flight.

In the field of service improvements, there has been a further reduction in average speed of long distance connections and in service errors in local calls. Troubles on subscriber lines have been reduced and the time for clearing troubles has been shortened. The elapsed time between the signing of a customer's order and the installation of service has been further reduced. There has been progress in treating each contact between the user and the telephone service on the basis of personal consideration in each instance.

Not only may the officials and personnel of the Bell System be proud of their record for 1929, but everyone who is a part of the telephone industry outside the Bell System may be proud of the achievements of the largest unit in the field. The Bell System has advanced and those companies outside the Bell System have advanced, and each worker in either group may enjoy his full share of satisfaction in having contributed his bit.

Straightforward Trunking Studies

Straightforward Trunking Is an Outstanding Development in Manual Operating Practice. The Story of Its Development at Rochester, N. Y. Is Told in a Series of Articles by E. R. Stonaker* and E. R. Costich**

E. R. Stonaker, Consulting Traffic Engineer, Rochester Telephone Corp., Rochester, N. Y.

Although the straightforward method of trunking calls between telephone offices is practically as old as the scheme of trunking, its application, until very recently, was confined to ring down trunks and toll lines and, in a few isolated cases, to automatic trunks.

It was only when the call circuit method of trunking, relatively large traffic loads between offices in the same multi-office city or local traffic area, practically broke down under the stress of war and post-war traffic conditions; that serious attention was directed toward developing the straightforward method to apply to this type of traffic.

In the majority of cases where this operating method and the equipment to make it possible has been applied the main thought has been to tide over a manual plant for a short period of years until dial equipment is installed. The straightforward systems have, therefore, had to labor under the limitations of using existing equipment to obtain the operating features desired.

Indeed the term "appliqué" has been adopted as best describing the equipment unit which is applied to existing call circuit apparatus to convert it to straightforward operation.

In the Rochester, New York, situation, however, this condition did not exist.

Two new manual central offices, out of a total of seven in the city, had only just been cut into service when this straightforward trunk study was made. The problem, therefore, was not so much one of applying the straightforward equipment to existing apparatus, as it was one of starting new with a clear slate to develop the most efficient straightforward trunking equipment, consistent with economy of investment, maintenance and operation. The equipment designed on the basis of these studies, which were more extensive than any yet made of this operating method, is probably the most efficient type of this equipment yet developed.

So that the difference between the two types of inter-office trunking may be clearly understood a brief description of both follows:

Call Circuit Method

The "A" operator, upon receiving a request for a connection to a subscriber in another central office district, depresses a call circuit key bearing the designation of the desired office. This operation connects her telephone circuit to a pair of conductors, known as a call circuit, which terminates at the called office in a "B" operator's telephone circuit, and over this call circuit she passes the number desired to the "B" operator. This operator in turn selects an idle trunk from among the group of trunks from the calling office and assigns that trunk for the connection by passing its number back over the call circuit to the "A" operator, who continues depressing the call circuit until she receives the assignment from the "B" operator. After receiving the assignment the "A" operator releases the call circuit key and plugs the calling end of the cord pair used in answering the subscriber into the jack of the assigned trunk, while the "B" operator inserts the plug on which this trunk terminates at her office into the jack of the called subscriber's line, thereby completing the connection.

Straightforward Method

Under straightforward operation the "A" operator, upon receiving a request for a similar connection, herself selects an idle trunk to the desired office which

E. R. Costich, Traffic Engineer, Rochester Telephone Corp., Rochester, N. Y.

is then either manually or automatically connected to a "B" operator's telephone circuit at the terminating office. Upon receipt of a tone signal, which is returned over the trunk as soon as it is connected to the "B" operator, the "A" operator passes the called number over the trunk and the "B" operator thereupon disconnects her telephone circuit from the trunk and inserts the trunk plug into the jack of the called subscriber's line.

History of Development

In order to clearly visualize a picture of the situation which existed in Rochester City with respect to the trunking problem, it seems necessary to briefly narrate the history of the development of Feature "A" Board equipment and Straightforward Trunk "A" and "B" Board equipment, as adapted to the multi-office operating system in Rochester City.

After considerable study of both key and automatic listening straightforward trunk circuits, as developed by Rochester Telephone Corporation and Stromberg-Carlson Company engineers in collaboration, key listening equipment was installed at the Glenwood "B" board. The reasons behind the decision upon the key listening type were mainly as follows:

First: It was desired to keep the cir-

*Consulting Traffic Engineer, Rochester Telephone Corp. and Stromberg-Carlson Telephone Manufacturing Co., Rochester, N. Y.

**Traffic Engineer, Rochester Telephone Corp., Rochester, N. Y.

cuit as simple as possible, from the equipment operation and plant maintenance viewpoint.

Second: Lamp indication not yet having been developed, it was found that a high percentage of long delays was encountered at the "A" board on calls falling into the higher sequence at the "B" board, in the case of automatic listening equipment.

Third: It was thought that such delays could be controlled on key listening equipment by correct provision of "B" operators.

The operation of the key listening type having been considered satisfactory at the Glenwood office, this type was also installed at the Culver "B" board, a central office equipment, having features applied to the "A" board cord circuit designed to increase "A" operator efficiency.

A study of this installation was made after its installation to determine the relative efficiency of this feature "A" board equipment as compared with Old Type Manual equipment when applied to multi-office operation.

On the basis of this study, which indicated that there was enough gain in efficiency to warrant continuing with the installation of this type of "A" board equipment, the feature cord circuit was redesigned to more closely meet the requirements of multi-office operation and was installed in the new Monroe Central office, at that time in process of installation.

This office replaced two former offices designated Park and Chase and all of the objectives set for it in the study of the Culver equipment were attained, except insofar as it was handicapped by the key listening type of straightforward trunking equipment.

Early in this Culver study it had become evident that the type of straightforward trunking equipment in use at Glenwood was putting a distinct drag on the Culver "A" operators, resulting in a high percentage of "A" answers over 10 seconds, and it was evident that the high load possibilities, inherent in the feature type of "A" cord circuit, could never be realized if the type of straightforward trunk equipment installed at the Glenwood and Culver offices were adopted as standard for the city. Accordingly, it was decided that a study of the entire trunking situation, as it applied to Rochester City, be made and that a type of equipment based on such a study be developed and adopted.

Included in the straightforward trunking equipments studied were Key-listening, Automatic-listening, Master Ringing Key Set, Master Busy Back Key and Appliqué Equipment, as applied to the "B" board and Group Busy Test, Idle Trunk Lamp Indication and Trunk Hunting Switches as applied to Trunk Selection at the "A" board.

Net Result of This Study

The net result of this study, which is contained in this paper, is that, not only was the necessary speed of operation which was desired, obtained—a speed even greater than that which would be obtained by the installation of trunk-hunting switches—but another very desirable object has been attained in that the circuit has been kept simple and free of such equipment operations as might give rise to an undue amount of plant maintenance difficulties. Furthermore, higher "B" operator loads have been maintained on this equipment than on any type of "B" equipment so far developed, either call circuit or straightforward.

The following enumerates the objectives attained by this equipment as applied to the various items of service:

1. *"A" Position Loads.*

The adoption and installation of the type of equipment recommended brought about an increase in "A" position loads, and a corresponding decrease in "A" position and operator requirements, of approximately 10 per cent. Although but 20 per cent of the total originating traffic of the office observed was affected by this equipment, loads of 218 calls per busy hour occupied "A" position, with 70 per cent local trunked traffic, were obtained during the observed periods.

2. *"B" Position Loads.*

The result at the "B" board was an increase in loads and a corresponding decrease in position and operator requirements of better than 20 per cent over the results being obtained with the type of trunking equipment previously in use. Although "B" loads averaged 700 calls, with 80 per cent occupied time, during the observed periods, this new equipment is being engineered on the basis of 650 calls per 80 per cent occupied time, in order to be conservative.

3. *Service.*

At the same time these high loads were being handled a subscriber service rating of between 80 and 90 points, on a 100 point rating basis, was shown by the observations. When this type of equipment was cut into service the per cent of answers to line signals over 10 seconds dropped from 13 per cent to 5 per cent and the average "connect interval" dropped from 18 seconds to 10.3 seconds.

4. *Force Re-action.*

The general comment of the "A" operators who handled traffic routed over this new equipment was that it was a great improvement over any method with which they had previously had experience. The Culver and Monroe "A" operators got into a frame of mind where they almost dreaded receiving a call to any office other than Main, where the trial installation of this equipment was in service.

The comment of "B" operators who operated these trial positions was to the effect that both key listening straightforward and call circuit equipment is vastly inferior to the type of automatic listening straightforward equipment finally developed. Like the "A" operators, they finally got in to the frame of mind where they dreaded being assigned to the call circuit and key listening "B" positions. They felt that the job they did on this newly developed equipment was much better than on any other, from the standpoint of loads carried, speed of operation and accuracy of connection. They furthermore felt much less fatigue after handling greatly increased loads on this new equipment than when handling distinctly lower loads on the other types of equipment.

Supervisory Central Office employes previously not particularly favorably disposed toward straightforward trunking, as compared with call circuit operation, having had experience only with the key listening type, all agreed that this new equipment put an entirely different light on the situation, and they are now distinctly in favor of the new straightforward method.

5. *Public Re-action.*

There has been received from subscribers and the public affected, considerable favorable comment on the manner in which connections routed over this new straightforward equipment have been speeded up. A case in point is that of a subscriber whose residence telephone is served by Monroe Exchange, while his business telephone is served by Main. This subscriber spoke particularly of the efficient manner in which the calls to his office telephone in the Main Exchange were handled, where, after giving the number to the operator he almost immediately heard a slight "toot! toot!" and then, immediately thereafter, the ringing signal and connection with his office. His comment was to the effect that the whole operation on these calls was expeditious and businesslike, "whistle and all," as he expressed it, whereas that on calls to other offices where this new straightforward equipment had not yet been installed, impressed him as being slow and cumbersome in comparison.

6. *General.*

The manner in which operating force and public opinion alike has confirmed the results indicated by observations is most conclusive. There has been no necessity for "selling" the method to those dealing with it or affected by it. It sold itself.

One of the very valuable points about

(*Continued on next page*)

Studying Telephone Methods

This Is Chapter 37 of a Series of Articles Written by E. R. Collins, Manitoba Telephone System, Brandon, Canada.

In our study of the automatic telephone, we have so far considered a system capable of serving only one hundred lines. The equipment studied so far is not sufficient to operate a system suitable to give service for general telephone purposes. We can, however, make admirable use of the 100-line unit as studied to give service to an isolated system, such as would be used in a manufacturing plant. In addition to the regular telephone service there are additional services that can be given, such as fire alarm, night watchman's clock service, conference line, and the code call system.

Fire Alarm Service

It is customary in factories to have a volunteer brigade of certain picked employes. It is their duty when an alarm is given to gather as quickly as possible at the danger point. Usually fire-fighting equipment is located in convenient places throughout the plant, so the firemen must know as quickly as possible where the fire is. Sometimes the fire whistle is used to give the general location by a code system. This tells the firemen where to go all right, but it disturbs the whole plant as well, causing a general disorganization of the work in all departments. The simplest method of using the telephone system is to assign a number, say 00, for fire, and have this line terminate in the fire department of the works. Or the shop whistle can be operated by dialling "00" and giving the general alarm. Where this is done the circuit in Fig. 286 can be used. A 1,000-ohm relay is connected across the "00" line, and the line switch removed. The line terminal assembly may be unsoldered, but the private left connected to the connector bank. Then the calling connector private wiper finds battery from the B.C.O. coil of the "00" line switch. The line wipers immediately find a completed battery circuit, due to the hold coil shown in Fig. 286 being across the line. The calling connector will, therefore, cut through into the talking position. If this hold coil is supplied with an armature, the battery from the connector will pull it up, and the contact closed by this armature can be used to operate the big whistle, or a series of bells and horns on a party line which goes to all parts of the factory. When the regular firemen hear the alarm they step to the nearest telephone and dial No. 00. Then the calling party who has turned in the alarm can talk to nine firemen, if there are nine connectors idle at the time. The calling party can hold the line till all his men have answered and learned the location of the fire.

Conference Line

It is quite obvious that all the connectors of the board could be connected to the No. 00 line at one time, and allow 10 people to talk together, as though they were on a party line. This feature can be used to get several men together for a short period for a conference. Two or more employes can be notified to call the conference line at a certain time, when, say, the manager wishes to discuss some point or give instructions. The conference line only requires the circuit shown in Fig. 286. The hold coil serves only the purpose of bringing all the connectors into the talking position.

As I look at Fig. 286 I notice that there is a bad mistake. It might be as well for purposes of discussion to leave the error as it is, as it will help impress the point on the minds of at least some of our readers. If the privates of the No. 00 bank contacts are all connected together, as they would normally be, then the first connector calling the No. 00 line would cut through and busy the No. 00 private contact for the whole set of banks. Therefore, any other connector calling this line would get the busy test. This applies to the fire trunk as well as the conference line. However, it is a simple matter to overcome this. The private contacts are multiplied together. Therefore, there will be two wires on each contact, except the end bank. Cut one wire off at each private bank contact (No. 00) and pull the wire back through the bank wiring. Connect a 1,000-ohm non-inductive resistance, one to each of these wires. Then connect the other side of the resistance to negative battery, through a suitable fuse, of course. Then each private contact of No. 00 will have an individual battery feed. Now a connector calling the No. 00 line will ground only the contact to which it is connected. All other contacts of this number will still have negative battery supplied through the individual coils. *For practice draw out the circuit as it should be for* 10 *connectors.*

Tone Set

In the last chapter we made reference to clearing trouble in a line switch bank, using a tone and finder coil. A steady tone is often very annoying, as it causes interference on working lines, and the continual hum of the buzzer might easily be mistaken for a switch in trouble. An interrupted tone can be supplied by the tone box circuit shown in Fig. 287. This employs two relays and a 6-volt battery. When the battery switch is closed, battery flows through both relay windings. Relay "A" will commence to buzz as a

CONVENTION SCHEDULE.

Oklahoma Utilities Associatoin, Tulsa, New Tulsa Hotel, March 11, 12 and 13.

North Dakota Telephone Association, Grand Forks, Hotel Dakotah, March 11, 12 and 13.

Texas Independent Telephone Association, annual convention, Hotel Texas, Fort Worth, March 18-21, 1930.

Iowa Independent Telephone Association, Des Moines, Hotel Fort Des Moines, April 8, 9 and 10.

Ohio Independent Telephone Association, Columbus, Deshler-Wallick Hotel, April 15, 16 and 17.

Indiana Telephone Association, Indianapolis, Claypool Hotel, May 6 and 7.

Kansas Telephone Association, Topeka, Hotel Jayhawk, May 13, 14 and 15.

Up-State Telephone Association of New York, Rochester, May 21, 22 and 23.

Pennsylvania State Telephone & Traffic Association, Penn-Harris Hotel, Harrisburg, May 13, 14 and 15.

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the greatly simplified traffic operation which is inherent in this equipment is that it greatly reduces the operator training period, both for "A" and "B" junior operators. Thus considerable otherwise unproductive money is saved. This same simplified operation increases loads, speed and accuracy and produces less fatigue in the case of experienced operators.

This simple operation is mainly brought about by the application of the lamp indication automatic listening feature to "B" equipment having master ringing key, master busy back key, with over-lap possibilities.

It is felt that this equipment is a logical development of the application of feature manual methods to the multi-office operating problem.

buzzer, and relay "B" will pull up. The springs 2 and 4 of relay "B" are much lighter than springs 1 and 2. Therefore, there can be quite a follow-up of springs 2 and 4 when the armature of "B" pulls up. This allows the core of "B" to become well saturated before the contacts open, and also allows the current to flow through "A" a longer time. This allows "A" to send out a tone while the armature of "B" is pulling in. The slow-acting feature of relay "B" will delay the release of its armature after the current to "B" is cut off. Therefore, when "B" is operated fully there will be no tone sent out. This works out to give a tone period shorter than the no tone period. In this way the minimum of interference is caused in the exchange. A little practice in adjusting the two relays will give the results desired. In this circuit we have an example of a *pulsing relay*, or a relay that will give a series of impulses. The length of the impulse and the frequency of the impulse can be regulated to a certain limit by adjusting the spring tension and the residual screw of the "B" relay.

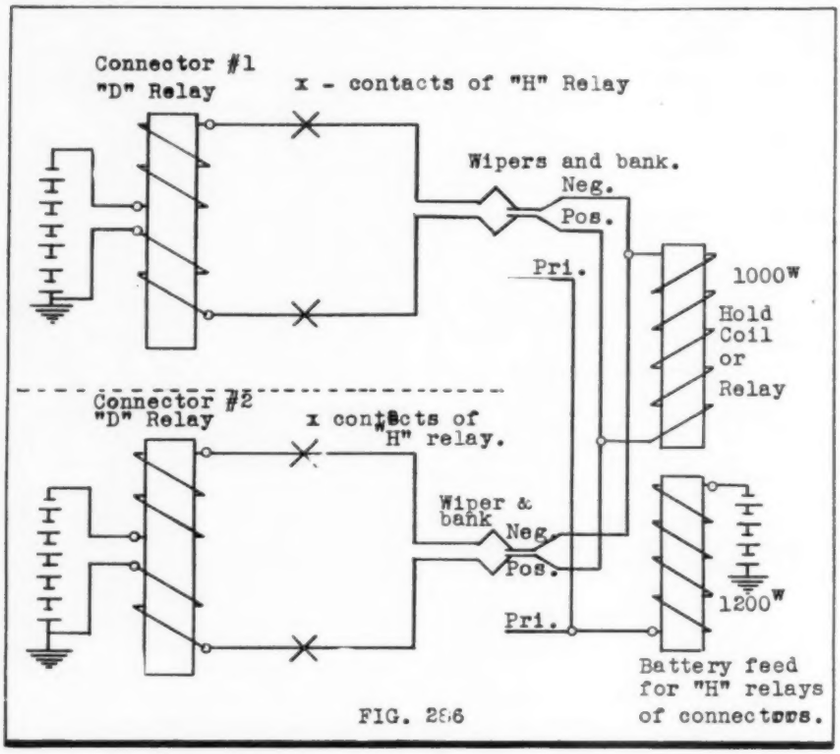


FIG. 286

Pulsing Relays

The time period of the impulses in Fig. 287 are comparatively short. In Fig. 288 we have a series of four slow acting relays similar to the "B" type relay used in the connector circuit. They are connected in a very simple circuit. Battery is applied by closing the start key. Then battery flows through the winding of "A" through the normal contact of "D." Relay "A" operates and closes the circuit to relay "B." Relay "B" operates and closes the circuit to relay "C." Relay "C" operates and closes the circuit to relay "D." Relay "D" operates and opens the circuit to relay "A." Relay "A" is slow to release, but when it releases, it opens the circuit to relay "B." Relay "B" is slow to release, but when it releases it opens the circuit to relay "C." Relay "C" is slow to release, but when it releases it opens the circuit to relay "D." Relay "D" is also slow to release, but when it releases it closes the circuit to relay "A" again. And so on the whole cycle keeps repeating as long as the current is applied.

Relays of this type have a time period of about .004 seconds to pull up and about .319 seconds to release. Therefore, adding the pulling-up time together for the four relays, and the release time of the four relays, we have 1.286 seconds for the complete cycle. We can increase this time by adding more relays to the series. The spring tension and the residual adjustment and the collar on the relay coil are all factors determining the time required to complete the cycle.

Another method of obtaining a pulsing movement, is shown in Fig. 289. Here we have three relays, "A", "B" and "C". Relays "A" and "B" are slow release type, while relay "C" might be a vertical magnet, or any other coil we might wish to operate at a given speed of impulses. When the battery key is closed, battery will flow through the 500 ohm, noninductive resistance, through relay "A". Relay "A" will operate and close the circuit to relay "B". When the battery key was closed, battery also flowed through relay "C" through the normal contact of relay "B". But relay "B" will also operate and open the circuit to "C". Then the make contact of relay "B" places a ground between the winding of relay "A" and the 500 ohm coil. This cuts the battery supply off relay "A". This is a slow release relay, but when it releases it removes battery from relay "B" again. Relay "B" being slow to release will pause before it releases to remove the shunt from the battery supply to relay "A". In this way the cycle of operations is continued. It is quite apparent that every time the armature of "B" operates, it causes the armature of relay "C" to release, and "C" being a quick acting relay can be used to perform any work desired. Relay "C" might be the vertical or rotary magnets of a switch, or the motor magnet of a rotary switch such as shown in Fig. 291.

A large range of adjustment can be obtained with the combination shown in Fig. 289, and will be found embodied in the circuit 292.

Cam Springs

There is another attachment to the regular connector switch which has been studied, namely, the shaft cam and springs. The cam is a piece of metal clamped around the switch shaft just below the hub of the shaft. Associated with the cam is a spring assembly so placed that the finger of the cam will press against the bushing of the main spring of the cam spring assembly. In ordinary cases the finger extends the full length of the cam, so that if the shaft is rotated 11 (eleven) impulses, the cam springs will be operated, while if the cam is rotated only 10 impulses, the cam springs must remain normal. Improper adjustment of the cam on the shaft will sometimes cause trouble by opening the cam springs when on the 10th impulse

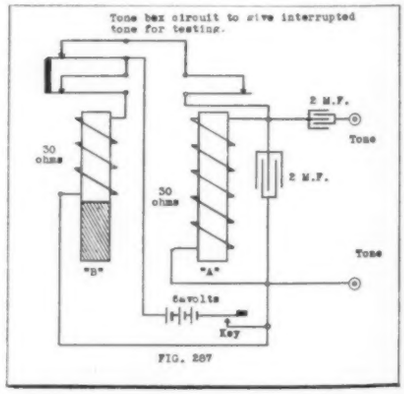


FIG. 287

step. This condition must be guarded against. Then the finger of the cam can be cut as in Fig. 290, so that the cam springs will only operate when the shaft is up on a certain level, or possibly more than one level. For purpose

of study in this chapter we will adjust the position of the cam on the shaft so that the cam springs will only operate when the shaft is up on the 7th level, and in 10 (ten) steps. This of course would happen when number 70 was dialed. The position of the cam and springs is shown in Fig. 290 in the operated and normal positions. Different spring assemblies can be used to suit each type of service. For our purposes, a set of make and break springs will be all that is required.

Code Call Equipment

Now we come to a very useful type of service known as the Code Call. It finds its greatest use in factories, and public institutions. The method of operating is quite simple. In short there will be a party line of bells, buzzers, electric horns, lamps, compressed air whistles, industrial horns, or even the main factory whistle, all electrically operated by current applied by a suitable relay. The usual custom is to apply 110 volts A. C. from the lighting mains by

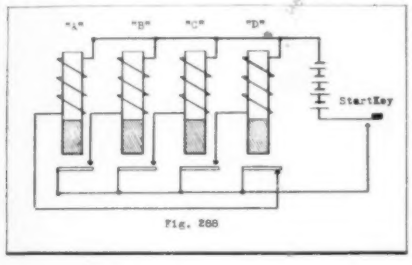


Fig. 288

means of a high voltage relay, to operate the signals connected to the line. The type of signal used will depend on the character of the room where it is installed. Suppose then that this party line can operate a suitable signal in every department of the factory. Each man such as the superintendent, or other executive (whose duty takes him to every nook and corner of the establishment), who is often wanted in a hurry, has a code ring assigned to him. When he is away from his regular telephone, the party calling him simply dials No. 70, and the code number assigned to the man. For example, if the superintendent has a code ring of 4, then calling 704 will start the code bells ringing - - - -, and repeat until the superintendent hears the signal, and steps to the nearest telephone and calls No. 79. This stops the signals, and connects the superintendent with the party calling him. It makes no difference where the call originated, or where it was answered from. The calling number is No. 70 plus the code ring, and the answering number is always 79 for the system shown in circuit No. 291.

The code call machine consists of two rotary switches of the type shown in Fig. 291. We have already studied the principle of operation of this switch. One switch has a wiper assembly and bank assembly consisting of three sets. This switch is used as the code selector, as shown in Fig. 292. The other switch has two sets of wipers, and is called the interrupter. There is also a relay assembly consisting of 8 relays, and an additional high voltage relay. This relay is not necessarily mounted in the code machine cabinet, but preferably is located as close to the centre of the party line as possible so that the current may be more evenly supplied to the signal devices. In some cases several of the high voltage relays may be located in different buildings, and are connected to the code machine by a pair in the telephone cable. The lighting current is then supplied locally for each building. In any event the high voltage relay can be considered as separate from the code call machine proper.

In the lower part of Fig. 292, a portion of the connector switch calling No. 70 is shown. We have shown the cam springs added, and also added a make contact to the "H" relay from the rotary magnet circuit. Assume that No. 70 has been called. Then the wipers of the connector will be driven to line No. 70 contacts on the bank. At the same time that the double dog drops in behind the 10th step of the rotary hub, the cam springs switch from generator to the new make contact of the "H" relay. The private wiper of the calling connector finds battery on the private contact of line No. 70. This causes the "H" relay of the connector to pull in. The "H" relay of the connector pulls up through its 125 ohm winding, and closes

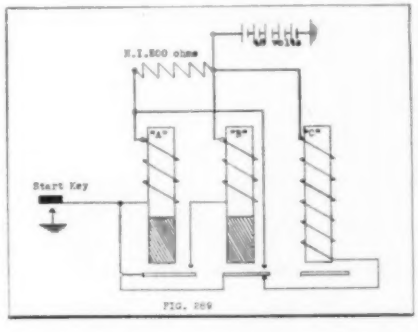


FIG. 289

the circuit of the 1,300 ohm winding of "H". Therefore "H" locks itself in an operated position. The line wipers of the connector are now connected to the line contacts of No. 70. It will be noticed that the line contacts are connected to the line contacts of line No. 79. Only the positive of No. 70 is connected to the negative of No. 79, and the negative of No. 70 to the positive of No. 79. The line switch of No. 70 and No. 79 are both removed, so that the contacts of No. 79 will otherwise be dead. Now the rotary impulses of the connector have ceased, and the "H" relay has switched the impulse wire from the "A" relay of the connector, so that a circuit can be traced from the ground at "A" of the connector, make contact of "H", make contact of cam springs, normal contact of relay "F", make contact of "H", positive wiper through cable to code machine, and normal contact of "B" of code machine, normal contact of "C", through winding of relay "E" to the rotary coil of the code selector, to main battery. This extends the impulse circuit from the

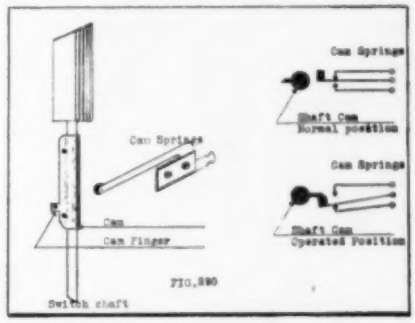


FIG. 290

"A" relay of the connector so that if the calling subscriber dials 4 the code selector switch will rotate 4 steps and drive its wipers to the 4th contact. It must be remembered in this type of switch such as the code selector, *that the operation of the rotary magnet pulls the armature up, but does not move the wipers.* When the current is cut off the armature in releasing drives the wipers. This is just the reverse action to the operation of the connector switch. The negative wiper of the connector completes the circuit to pull in the "F" relay of the connector. But the negative contact is still open, so that the "F" and the "D" relays of the calling connector will not operate.

Consider now that the wipers of the code selector are all three resting on the 4th contacts of their respective banks. Battery flows from the "D" relay of the code machine, through the normal contact of "B" of the code machine through the 125 ohm winding of "H" of the connector to ground. This operates "D" of the code machine.

Code Machine Operation

While the impulses are being sent to operate the code selector, the "E" relay is operated. When "E" releases upon the completion of the train of impulses, it places ground on its armature. This completed a circuit to the W1 of the code selector, which now stands on No. 4 contact of the bank No. 1 of the selector and this ground is therefore extended back over the bank wiring (Bank No. 1) and closes a circuit to operate the "C" relay.

Relay "C" operates, and opens the circuit to the rotary magnet of the code selector. This prevents any further impulses from relay "A" of the connector from changing the position of the wipers of the code selector. Relay "C" also closes a circuit from relay "D" but as

relay "D" is now operated no change takes place.

Common Operating Ground

Now follow the circuit from ground at relay "E", which in addition to operating relay "C" extends a ground to the armature of relay "F" which is not operated, to the armatures of relays "A" and "K" which are still normal, and to the rotary magnet of the interrupter which will now pull up. The winding of relay "A" is also grounded and "A" will pull up. "A" closes the circuit to "K" which will now operate. Relay "K" pulls up and shunts the battery supply to relay "A" through the 500 ohm noninductive winding. When "K" operates it opens the circuit to the magnet of the interrupter, which allows its armature to drive

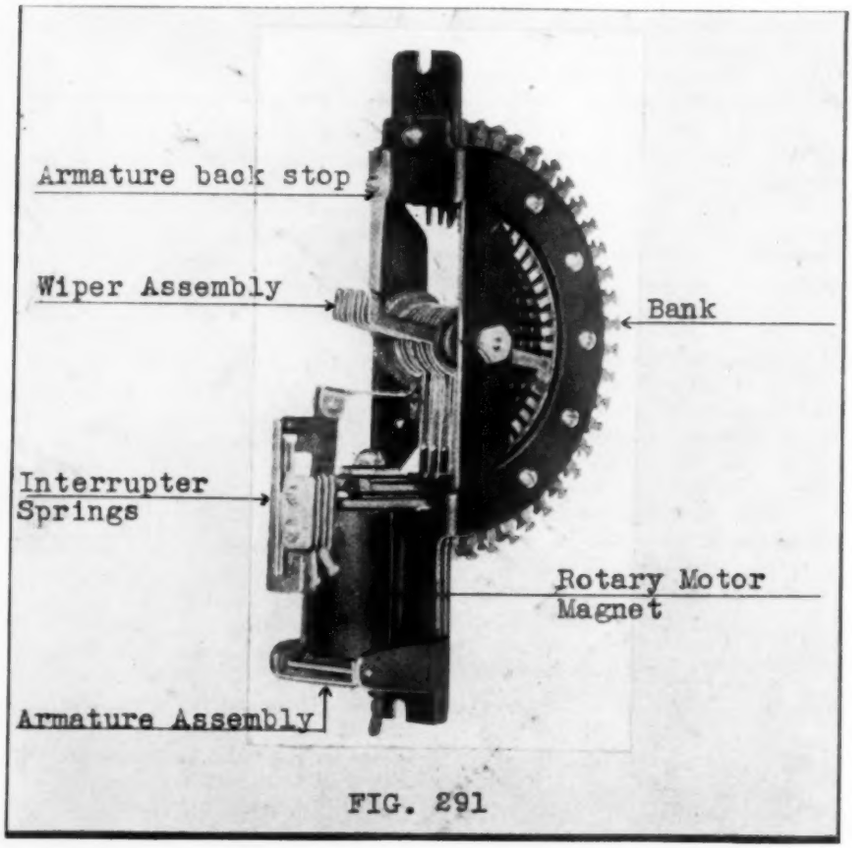


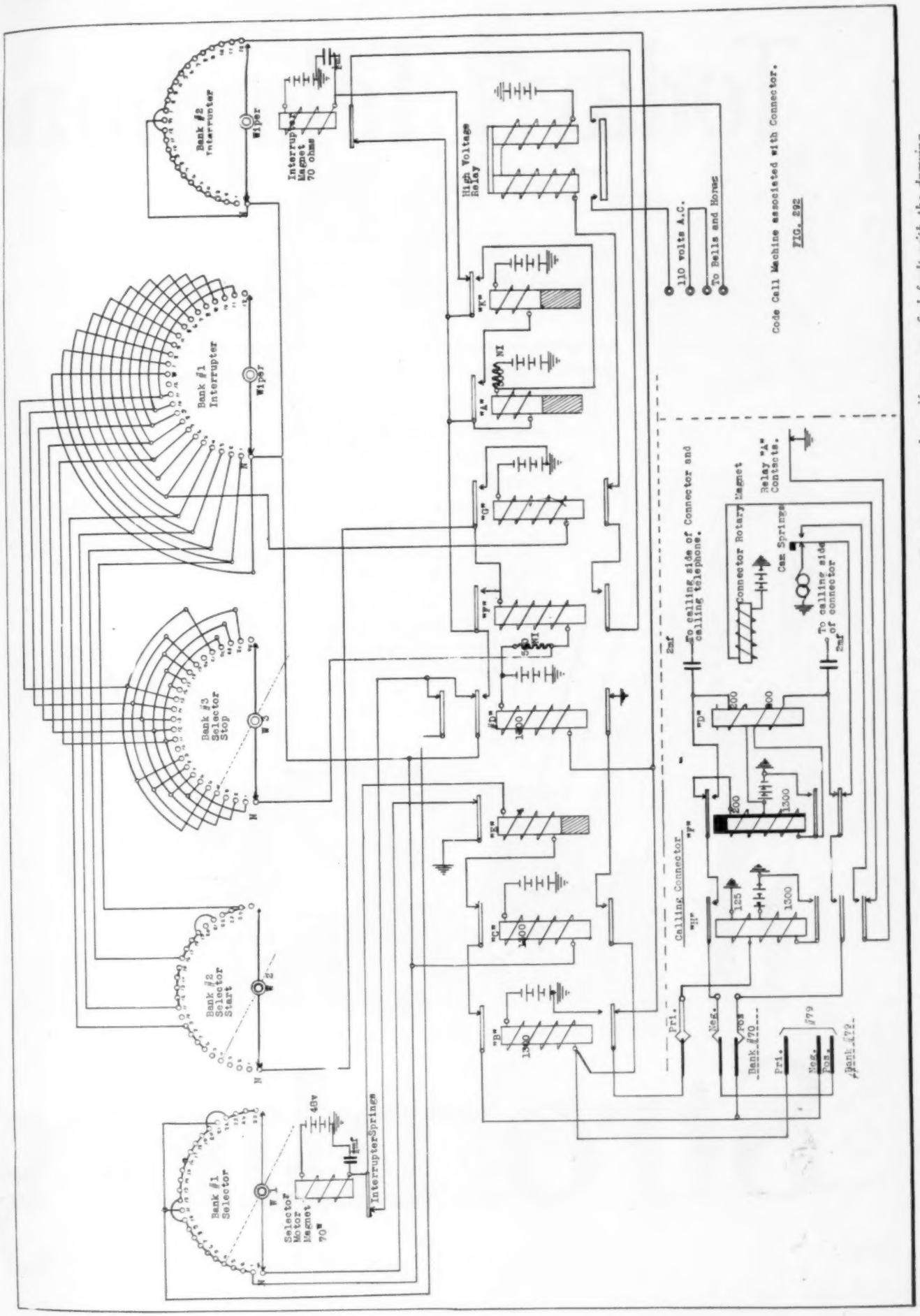
FIG. 291

the wipers to the 1st contact of bank No. 2 of the interrupter. Relay "A" drops releases from the shunt on its battery supply and opens the circuit to "K". This relay in turn releases and opens the shunt circuit to "A" and closes the circuit to the interrupter magnet. The interrupter armature pulls up and when "K" is again operated, the wipers of the interrupter are driven to the 2nd contact of the interrupter banks. The relays "A" and "K" are the impulse relays to supply the impulses to the interrupter magnet. Thus step by step the wipers of the interrupter are driven across the banks. It will be noticed that the wipers are resting on the bank contacts all the time that it takes the slow release relays to drop out. The impulse time is divided so that the current flow in the rotary magnet of the interrupter is of short duration. This prevents overheating. Incidentally, the pull up period of this magnet corresponds to the pause between the rings of the code bells. The time the wipers are resting on the contacts corresponds to the time the current is applied to the code bells. This gives a longer ring and a short pause. Where 25 cycle current is used to ring large bells if the ring time is too short, the bells will not ring properly.

Code Wiring

Now bank No. 2 of the interrupter is wired in two sections. That is there are 12 working contacts required, and 26 contacts on the bank. Therefore by making a multiple of the wiring the wiper will only traverse ½ of the bank to complete its cycle of operations. The contact No. 13 of bank No. 2 will be the same as the normal contact so that the wiper can find a normal position here as well as the position shown in the drawing. Now if you trace back the wiring of bank No. 1 which, by the way, is also multiples similar to bank No. 2 of the interrupter, you will notice that contact No. 1 is connected to contacts 22-23-24 of bank No. 2 of the selector. Contact No. 2 of the interrupter is wired to 16-17-18-19-21 of the selector bank No. 2. Contact 3 of the interrupter is wired to 11-12-13-14-15 of the selector, and contact 4 to the 6-7-8-9th contacts of the selector bank No. 2. The selector wipers are resting on No. 4 of the selector as shown by the dotted lines. Therefore as the interrupter wipers travel over contacts 1-2-3-4, they find an open circuit. During this time the circuit to the high voltage relay is opened at relay "F". When the contact No. 5 of the interrupter is reached, a circuit can be traced from the battery at relay "G" to contact No. 5, to the wiper of the interrupter, to the common ground supplied from the armature of the "E" relay by way of the W1 wiper and bank of the selector. Relay "G" pulls up while the wiper is resting on contact No. 5. But relay "G" opens up the circuit to the high voltage relay also, so that when battery from relay "F" finds ground at the make contact of "G", and pulls in, it closes the circuit to the high voltage relay. But this circuit is now open at "G" so that the high voltage relay does not pull in. The upper armature of "F" is grounded, so that when it pulls in, it closes a locking circuit to relay "F". Now the rotary magnet again pulls up, and opens the circuit to the high voltage relay in a third place at its interrupter springs. When the wipers are driven to contact No. 6, they find an open circuit. Therefore "G" drops out, and closes the circuit to the high voltage relay. This circuit is now complete and the interrupter magnet has closed its interrupter springs, and a circuit can be traced from battery at the high voltage relay, through normal contact of relay "G", make contact of relay "F", normal contact of interrupter springs at rotary interrupter magnet, to the common ground supplied from *Relay "E"*. This causes the bells to ring once. The interrupter armature again operates and opens the high voltage relay circuit again. When contact 7 is reached, it is also dead as can be seen by tracing the wire back to bank No. 3 of the selector. Contacts 8 and 9 are also dead (trace these back). This allows the high voltage relay to operate 4 times causing the bells to ring 4 times. When contact 10 is reached, a circuit can now be traced from the grounded wiper of the interrupter, over contact 10 of bank No. 1 of the interrupter, back to contact 4 of the No. 3 selector bank, over wiper W3 to the 500 ohm noninductive coil supplying battery to relay "F". Relay "F" is quick release, so that it drops out as soon as the wiper closes its circuit. This opens the circuit to the high voltage relay so that the bells do not ring. The lock of relay "F" being broken it will not pull in again until the interrupter wipers have closed circuit to relay "G" from the next multiple of contact No. 5. The code will be repeated until the calling party hangs up, or the called party answers.

(*Continued on page 26.*)



Here is a circuit diagram of Mr. Collins' which will doubtless interest you. Put your mentality to a test and see if you can find fault with the drawing.

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Called Party Answers

When the called party answers by calling No. 79, his connector finds battery from relay "B" of the code machine, for the private wiper. This pulls in the "H" relay of his connector, and this connects the negative line wiper to the positive line wiper of the calling connector, which causes the "F" relay of the answering connector to pull in and puts the answering connector in a talking position. At the same time the negative wiper of the calling connector finds a circuit through the positive wiper of the answering connector, and the calling connector goes into talking position. The positive contact of No. 70 is already opened at relay "C", and is again opened at relay "B" which is now operated. When relay "B" pulls up it also grounds the private of No. 70. This had already been grounded from the common ground at relay "E" over the interrupter bank No. 2 and the normal contact of "B".

The code interrupter will continue rotating until the code has been completed, and until its wipers reach the normal contact. When the wiper of the interrupter bank No. 2 reaches the normal contact, it opens up the circuit from its bank back to the winding of the "D" relay. As this circuit is also opened at the "B" relay now, the "D" relay will release. This removes the common ground from relays "F", "A", "K", and the interrupter magnet. The operation of the interrupter apparatus then ceases. When "D" releases, it closes a circuit to contacts 11 and 21 of the selector bank No. 1. It also closes a circuit from battery at the selector magnet, through its interrupter springs, back to ground by way of the normal contacts of "D", Wiper W1, bank No. 1 of the selector to ground at the normal contact of relay "E". The selector armature will pull up, but when it does so its interrupter springs cut the circuit and it drops back again. This action continues as a buzzer action, until the wiper W1 is driven clear of the bank on to the normal contacts. This opens the circuit to relay "C" which closes the circuit to the selectro magnet. But this circuit is still opened by relay "B". As soon as the parties are through talking, the connectors are released, and relay "B' releases and the code machine is ready for another call.

The unfortunate part of the operation of this machine is that the codes does not always correspond to the figures dialed. The following is the code:

Number called	*Code sent*
1	-
2	- -
3	- - -
4	- - - -
5	- - - - -
6	- - -
7	- - - -
8	- - - - -
9	- - - - - -
01	- - -
02	- - - -
03	- - - - -
04	- - - - - -
05	- - - - - - -
06	- - - -
07	- - - - -
08	- - - - - -
09	- - - - - - -
001	- - - - - - - -
002	- - - - -
003	- - - - - -
004	- - - - - - -

It will be noticed that the digit 0 is placed before the code which would correspond to No. 11. When 0 is dialed 10 impulses are sent which drive the wipers of the code selector to contact 10 of the selector bank. Relay "E" had been pulled up while the impulses were being sent but when the wiper W1 stops on the 10th contact, the ground from relay "E" does not find a circuit to the impulsing relays, since contact 10 is wired separately to relay "D" which is now pulled up. Therefore the second digit sent will drive the wipers further into the bank. The same applies if two 00 follow one another. Contact No. 20 is likewise wired. Therefore if No. 05 is called we can trace out the operation of the code. The No. 05 would be contact 15 of the selector bank No. 2. This is wired to No. 3 contact of the interrupter bank No. 1. Therefore when the wiper of the interrupter bank No. 1 rests on contact No. 3, ground from this wiper finds a circuit back to No. 15 contact of selector bank No. 2, over Wiper W2, to the winding of relay "F". This pull operates "F" which will lock, through its make contact. The high voltage relay will now find a circuit, and will ring the bells once. Contact 4 of interrupter bank No. 1 will be dead, and therefore the bells will ring when the contact 4 of the interrupter bank is reached. When contact 5 is reached, the relay "G" pulls up and opens the circuit to the high voltage relay. This gives a pause of one impulse. Contact 6 is dead, as are contacts 7-8-9-10, therefore there will be a ring for each one of these contacts. When contact 11 is reached, ground is placed on this contact, and from there to contact 15 of bank No. 3 of the code selector. This completed the shunt to the battery supply of relay "F" and the high voltage relay circuit is opened. This gives the code 2 and 5 rings when No. 05 is called. It would be a good practice for the reader to trace out the combination required for each code on the list.

There is a more recent type of code calling machine where the number called will produce a code ring corresponding to the digits of the called number. We may possibly deal with this at a future time. It will be noted that the motor magnets of the selector and interrupter are each provided with a condenser for spark suppression. The small noninductive resistances are omitted but they are required to suppress the spark.

Gloversville, N. Y., Exchange Sets Record Traffic Load

By O. K. Durfee, Glen Telo. Company

Gloversville, New York, is a city of 22,000 and is located in the eastern section of New York.

The telephone requirements of the town are served by one exchange.

The switchboard is a Stromberg-Carlson Super-Service of eighteen positions, thirteen of which are used for local service. Two positions are used as "B" positions, one as a hospital position, and two are unequipped.

The traffic load on December 23, 1929, broke all previous records. From midnight of December 22 to midnight of December 23, 52,511 calls were handled. This figure does not include the incoming inter-office and long distance which amounted to 3,263. The average twenty-four hour load is around 32,000.

What caused the load to jump was a real old fashioned snow storm, which began at noon, and continued all afternoon and evening, until there was about 14 inches. With such conditions, we looked forward to a record load on December 24, and it came. From midnight of December 23 to midnight of December 24 the meters registered 57,369 calls. Add to this figure the 3,322 incoming inter-office and long distance calls, we had a total of 60,691 and that with a station count of 6,250 and 2,850 lines.

During the eleven hour period from 8 a. m. to 7 p. m. 46,168 calls went through, or an hourly average of 4,197. The average number of operators on duty during that period was eleven and they handled an average of 381.5 calls per hour per operator.

The greatest number of calls handled on one position in one hour was from 11 a. m. to 12 a. m. and totaled 576 thus the operator handled the calls at the rate of approximately 10 per minute.

The peak load on the batteries came at 9:30 a. m. and was 75 amperes. The average drain for the eleven hour period was 49.43 amperes.

During the same period each of the 234 cord circuits on the switchboard was used, an average of 197.3 times.

There are 19 cord circuit relays (including master relays) operated for each call, or a total of 877,000 relay operations. Approximately 2,400,000 relay contacts were made. Not a single case of cord circuit trouble developed nor did any machine or piece of apparatus in the exchange require adjustment or attention.

The Generation of Carrier Currents

Generation of the Vacuum Tube.—Push-Pull Arrangement.—The Self-Oscillating Moderator, Etc.—This Is the Second of a Series of Articles on Carrier Currents by F. J. Dommerque, Fellow A. I. E. E.

Generaton by the Vacuum Tube

The generation of carrier currents by means of the vacuum tube has been described to some extent under the heading, "The Vacuum Tube as an Oscillator" in the TELEPHONE ENGINEER of August, 1928. To this description we will add some explanation which will make it more complete. As carrier currents are alternating currents of high frequency, the oscillations must be *undamped;* that is, the wave must have the same amplitude for each oscillation. To obtain this result part of the energy output of the tube is used to replenish the losses in the oscillation circuit formed by the inductance coil L and the condenser C, shown in Fig. 6 of the above-mentioned article.

The oscillations commence as soon as the plate circuit is closed. The frequency of the oscillations is conditioned by the natural oscillation of the oscillation circuit; that is, by the dimensions of the inductance L and the capacity C. This frequency may be determined approximately by the equation $f = \frac{1}{2\pi\sqrt{LC}}$. This equation shows that for a given frequency the product of L and C must always be the same for the frequency in question, regardless of the value of either.

In Fig. 3 of the February number of the TELEPHONE ENGINEER is shown the source of carrier current as a separate carrier generator. It is also possible to combine modulator and carrier generator into one implement. Black, Almquist and Ilgenfritz* have described a method how to effect this combination, which they call a "self-oscillating modulator."

Before we discuss this self-oscillating process, it will be advisable to take up several points in connection with the use of vacuum tubes.

Push-Pull Arrangement

This arrangement has been employed to great advantage in amplification. Difficulties had been met with in multistage amplification. The third stage already gave trouble by the requirement of delicate adjustments. Therefore a new circuit connection was introduced as a second stage which overcame this trouble. Instead of connecting a single tube by means of an interstage transformer to the first stage of amplification, two tubes were connected in parallel as shown in Fig. 1, thus the input voltage is divided equally between these two. The two halves of the output transformer of this "push-pull" arrangement, as it is called, are connected so as to form one coil with a tap at the center, the two halves being so arranged that the tube output is additive, whence the possibility of using double the input voltage with this arrangement as with a single tube, and thus effect a higher degree of amplification. By using the differentially wound transformer in the output circuit any troublesome interfering components due to modulation are equal in amplitude and opposite in phase, thus they are balanced out.

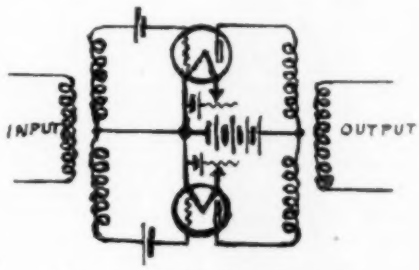


Fig. 1—Push-pull arrangement

This avoidance of interference is particularly desirable in the use of repeaters in multiplex telephone channels, when one repeater channel is employed only to amplify the carrier transmission instead of a repeater channel for each one of the multiplex channels. The push-pull arrangement will assist in avoiding, or at least in modifying, the effects of interaction of the currents in the various carrier channels.

A further application of the push-pull arrangement may be found in the "carrier suppressed system," that is a system in which the carrier current or currents are not sent over the line, but are produced and modulated at the sending terminal, but only one side band is sent to the receiving terminal. At the receiving terminal the carrier current is produced again and supplied to the demodulator. Reference may be had again to the article in the TELEPHONE ENGINEER of August, 1928, where on page 29 the carrier wave modulation is illustrated. The last two of the curves show the wave form with the carrier suppressed, when both side bands are present, and when only one side band is present, respectively.

In the carrier suppression at the sending terminal the push-pull arrangement appears in the form of the so-called "balanced modulator," a skeleton diagram of which is given in Fig. 2, which in all respects is similar to Fig. 1 except for the addition of the transformer T, by which the carrier current is applied to the input circuit in such a manner that the carrier frequency potentials of the two grids to the filament are at any instant the same. As the output currents of the two tubes are consequently equal for the carrier frequency and thus the fluxes in the core of the output transformer equal in amount but opposite in direction, no voltage of the frequency of the unmodulated carrier enters the output circuit. The side band currents, however, are reproduced in the output circuit.

The Self-Oscillating Modulator

The self-oscillating modulator is of the push-pull type and designed to suppress the carrier from the output, the lower side band only being transmitted over the line, as indicated in Fig. 3, which is reproduced from Black, Almquist and Ilgenfritz's paper on "Carrier Telephone System for Short Toll Circuits," which was given in abridged form in the July number of the TELEPHONE ENGINEER.

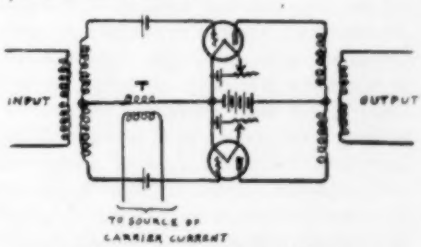


Fig. 2—Balanced modulator

According to the authors the generation of the carrier frequency oscillations is accomplished by causing the tubes T_1 and T_2 in Fig. 3 to oscillate in parallel, the potentials of both grids being alike and rising and falling together at a rate corresponding to the carrier frequency. As will be seen in the figure the grid circuit and the plate circuit of the tube are coupled by an oscillation circuit, consisting of an inductance coil L and condenser C; this oscillation circuit controls the frequency of oscillation as was explained earlier on page 29 of the August, 1928, TELEPHONE ENGINEER. The voice currents coming over the input transformer impress the voice frequencies upon the grids of the modulator

*Carrier Telephone System for Short Toll Circuits. By Black, Almquist and Ilgenfritz. Journal A. I. E. E. Dec., 1928.

tubes and jointly with the carrier frequencies undergo the process of modulation, which will be described in a later article on modulation.

Generation by High-Frequency Machines

As carrier currents are alternating currents of high-frequency, the idea suggested itself to construct alternating current machines, which produced the desired high frequencies. The first machines of this kind were built to serve radio purposes. In this country Alexanderson has constructed the first alternator which could be used for multiplex telephony and was used for this purpose, although only experimentally, by General Squier* as he described it in his epoch-making paper on "Multiplex Telephony and Telegraphy by Means of Electric Waves Guided by Wires." It is not our intention to go into the details of this paper, but we will briefly speak of the alternator. This machine was of the inductor type and was designed for a frequency of 100,000 cycles; it was run by a motor with a normal speed of 1,250 revolutions per minute, which was connected by a chain drive to an intermediate shaft which run at a speed of 2,000 revolutions per minute. The intermediate shaft drove the flexible shaft of the alternator through a De Laval turbine gearing, having a ratio of ten to one. The flexible shaft and inductor thus revolved at a speed of 20,000 revolutions per minute.

This method of propulsion was rather cumbersome. Subsequently Tesla and Alexanderson designed high frequency alternators for direct production of the high frequency. The Tesla alternator did not find practical application, but the Alexanderson alternator was usefully employed in radio sending stations, but not in multiplex telephony, probably on account of the more convenient electron or vacuum tube, perhaps also, because on the face of it, it would appear as if production of carrier currents by high frequency generators would be more costly than by vacuum tubes, a question, however, which has not been decided up to this day.

The Alexanderson high frequency alternator differs in construction from the regulation alternator. In any ordinary alternator both the rotor (rotating member) and the stator (stationary member) are wound with wire. But the Alexanderson high frequency alternator has a rotor without any wire, as it would be difficult, in fact impossible, to accommodate wires in such a small space as the teeth cut into the periphery of the rotor would permit. This can be done in an alternator of the inductor type. Alexderson's rotor consists of a steel disk, very thin, but growing thicker toward the hub. Instead of teeth along the periphery he cuts slots on the two sides near the periphery and fills these slots with phosphor bronze, which is non-magnetic, to give the disk a smooth surfact. The variation in the magnetic flux is not obtained by the change from north

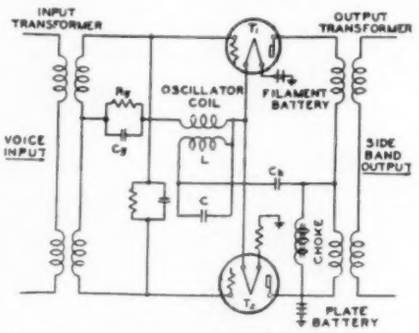


Fig. 3—Self-oscillating modulator. Carrier suppressed

to south pole, but by changing of the unidirectional flux in the rotor, a rotor tooth in this case corresponding to one pole and the slot following it to the opposite pole.

This field in the stator is stationary, while in the ordinary alternators usually the magnet system rotates and the armature is stationary. In the Alexanderson high frequency generator the armature conductors are laid zigzag in small, straight open slots in the flat face of the stator core as shown in Fig. 4, which is a section of the alternator, where these conductors are carried by the laminations shown at E. A is the field winding and B the armature. C is the steel disk with its hub. D is the iron frame through which the field flux passes. F is a slot filled with the non-magnetic material. To the right of the section of the machine is given a front view of an Alexanderson armature, and in Fig. 5 the rotor belonging to the same machine. The airgap of this machine is only 0.015 inch (0.38 mm.) wide. It can easily be imagined that operation of such a machine would be a very precarious proposition.

The French engineers to lessen the difficulty of cutting the very small slots in the Alexanderson rotors, placed several alternators on one shaft, thus dividing up the number of poles required.

It was principally in Germany where the high frequency alternator made progress in the battle with the vacuum tube, and that country is the only one which applied such machines in actual multiplex telephone installations. The Germans took up a different road to generate their high frequencies. Instead of directly generating the desired frequency by an alternator, they used alternators to generate a fundamental frequency which may be said to be a medium frequency; that is, a frequency considerably lower than the desired high frequency. This medium frequency may then be doubled, tripled, quadrupled, in fact it may be brought up to any even or uneven multiple of the medium frequency by the use of so-called "Frequency Converters" or "Frequency Multipliers." While the development of this kind of high frequency generation was going on, the laboratory of Alexanderson made investigations and experiments in the same direction.

Although, as stated before, we are in this discussion interested only in carrier currents as used in multiplex telephony, it will be expedient to devote some space to these frequency converters and multipliers.

Frequency Multipliers

In an alternator the frequency is determined by the formula $f = \frac{np}{120}$ wherein p designates the number of poles, n the number of revolutions per minute and f the frequency. It is supposed that the alternator is of general design. To obtain a high frequency either "p" or "n" or both have to be made high. There is, however, a practical limit to this, else the machine becomes dangerous to operate. To overcome this difficulty the German engineer Goldschmidt took an alternating current generator of such frequency as would not endanger its operation and built up large currents by means of electrical resonance in the rotor and stator circuits of the generator. This process of building up high frequency currents, the periodicity of which represents a multiple of the fundamental period, is known as the "Reflection Principle." It will receive a brief discussion in the following. The Goldschmidt method of building up the higher ,periodicity from the fundamental number of periods is schematically shown in the circuit of Fig. 6. As the Goldschmidt high frequency machine was designed for use in radio work, the circuit is drawn up with an antenna; this, however, is immaterial to the problem in question, as it is a well known fact that an antenna with the ground constitutes a condenser, the air between them being the dielectric. S is the stator and R the rotor of the machine. The battery B serves to energize the winding of the stator S; any other source of direct current, however, may be chosen for this purpose. The excitation of the stator causes a current to flow in the winding of the rotor revolving in the magnetic field of the stator; the frequency of this current is $f_1 = \frac{np}{120}$ periods per second. The alternating e. m. f. in the rotor is impressed by means of the slip rings on the circuit $C_1C_2L_2$ which is tuned so that $2\pi f_1 L_r = \frac{1}{2\pi f_1 C_1}$ and $2\pi f_1 L_2 = \frac{1}{2\pi f_1 C_2}$; these conditions of electric resonance

*Multiplex Telephony and Telegraphy by Means of Electric Waves Guided by Wires. By George O. Squier. Transactions A. I. E. E. June, 1911.

may also be writen as $(2\pi f_1)^2 C_1 L_r = 1$ and $(2\pi f_1)^2 C_2 L_2 = 1$, wherein L_r signifies the inductance in the rotor. Assuming the losses in inductance coils and condensors to be negligibly small, the e. m. f. for the frequency f_1 measured between the points A and D would be zero. According to Wirtz* the alternating field in the rotor may be regarded as composed of two fields rotating in opposite direction, the one of which, viewed from

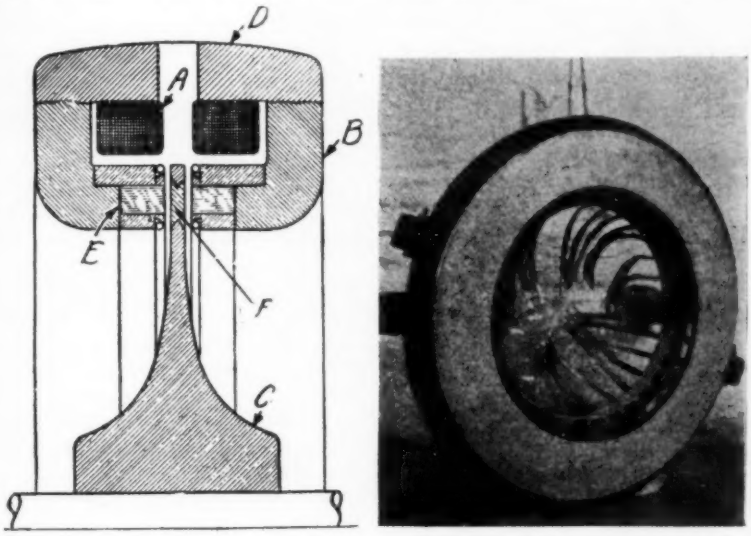


Fig. 4—Section and armature of Alexanderson high frequency generator

the stator, stands still, while the other rotates toward the stator with doubled speed; that is, it will induce in the stator an e. m. f. having a frequency $f_2 = 2f_1$. If the inductances and capacities $L_2 C_2 L_4$ are chosen for resonance at the frequency f_2, L_4 being the stator inductance, the conditions are expressed by the equation $(2\pi f_2)^2 \times C_2 \times (L_4 + L_2) = 1$. The frequency may be still further increased by

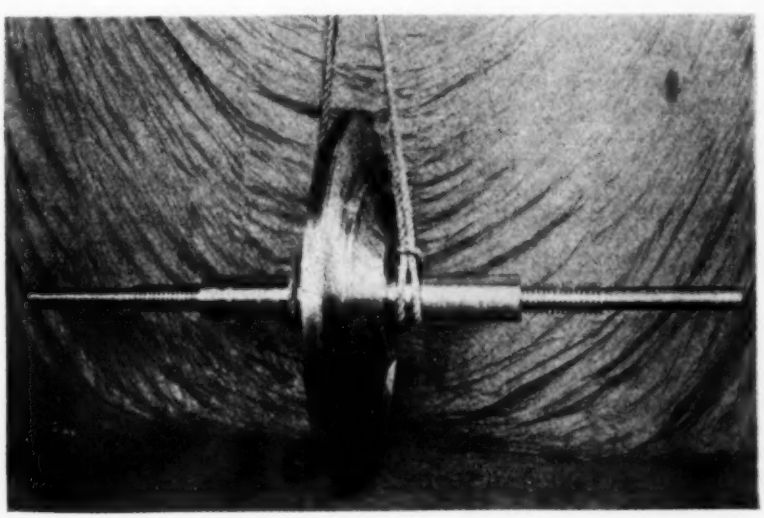


Fig. 5—Rotor of Alexanderson high frequency generator

choosing the inductances and capacities $L_r C_1 C_4$ for resonance at the frequency of f_2. The stator currents of the frequency f_2 cause a pulsation of the magnetic flux of f_2 periods in which the rotor revolves. The above described process repeats itself and gives rise to a flow of current in the rotor having a periodicity of $f_3 = 3f_1$. The electric quantities are fixed by the equation $(2\pi f_3)^2 \times \frac{C_1 C_4}{C_1 + C_4} \times L_r = 1$.

The condenser C_4 has such a capacity that the circuit $L_r C_1 C_4$ resonates to the frequency f_3. The f_3-period or cycle currents in the rotor cause a pulsation of magnetic flux toward the stator windings which has a periodicity of $f_4 = 4f_1$. It results a f_4-period or cycle e.m.f. in the stator. Designating the condenser formed by the antenna and ground by C_a we have the relation $(2\pi f_4)^2 \times C_a \times (L_a + L_4) = 1$.

The frequency may be increased in this manner still further, but it soon becomes uneconomical to do so.

Goldschmidt's high frequency alternators have been built and used for radio installations. In these machines the device for stepping up the frequency was made an integral part of the machine itself. In later installations of radio sending apparatus and also for multiplex telephony high frequency machines have been used which differ from the Goldschmidt machine in that the stepping up device is separate from the machine and takes the form of a transformer, which has been given the designation "Frequency Converter," although it is only another type of frequency multiplier.

Vacuum Tubes Versus High-Frequency Machines.

Lately engineers have given more attention and study to the development of frequency multiplication by means of frequency converters and it would be appropriate to explain their construction and function at this juncture. As this is, however, a somewhat lengthy story, this will be reserved for a later discussion. It may be opportune to conclude with an explanation of the reasons which prompted the engineers to devote their energy to building high frequency generators to take the place of vacuum tubes for radio sending as well as for multiplex telephoning.

Tubes are costly not only to purchase but also to maintain, as their life is limited. After a certain time they have to

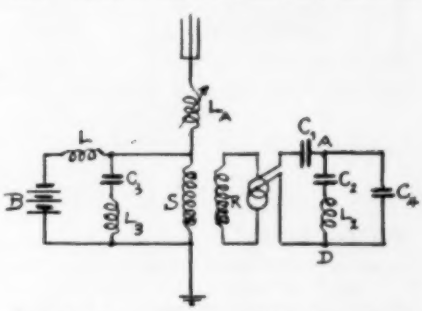


Fig. 6—Frequency multiplication circuit

be renewed and what is more the entire tube has to be renewed as the construction does not permit of part renewal. Of course a high frequency machine is more costly as far as its purchase is concerned, but when it comes to maintenance there is practically none of it, as machines of that type are constructed so perfect nowadays that they last for a great nummer of years. In addition to this the circumstance that the operation of large tubes requires skillful help while high frequency machinery can be attended to by anyone used to electric light and power-station work, speaks greatly in the favor of machines.

A disadvantage in the use of high frequency machines consisted in the difficulty to obtain constancy of waves, as the latter depends entirely on the constancy of the motor generators, which in the ordinary electric light and power systems is not easy to obtain. But this difficulty has been overcome by speed regu-

(*Continued on page* 31.)

*Rein – Wirtz. Radiotelegraphisches Praktikum. Page 59.

LINE AND DESK

AUTOMATIC INSULATION TESTER FOR TOLL CABLES.

A system for meeting the insulation of conductors in long toll cables is described by F. B. Anderson in Bell Laboratories Record. The device was developed in the Bell Laboratories and is now in field service. The skeleton diagram, Fig. 1, shows the essentials of its operation.

It is a type of a Wheatstone bridge in which the insulation of the line to ground is compared with a standard resistance of five megohms. A vacuum tube serves as the bridge galvanometer and operates or releases a relay to indicate the condition of the line. When the insulation resistance tested has fallen below five megohms, the relay releases and causes an alarm to be registered for the patricular line under test.

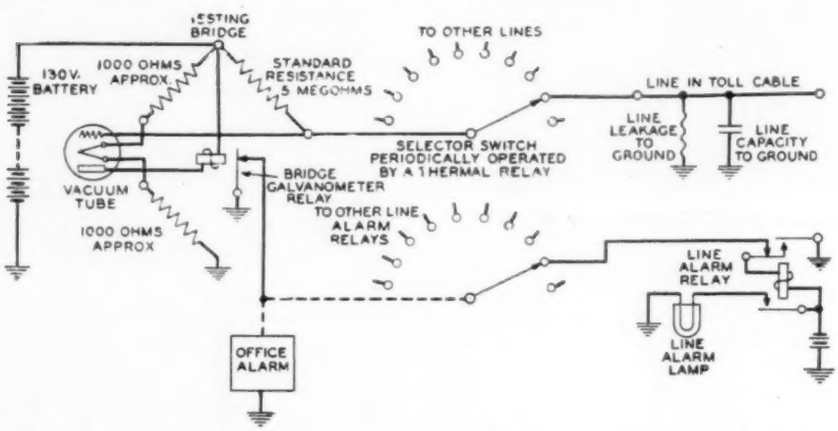


Fig. 1—A bridge to measure the resistance from line to ground, and a stepping switch to select successive conductors form, with suitable alarms, the essentials of the scheme

A sector switch is regularly stepped ahead by a slow acting thermal relay about once every minute and each step a new line is tested. Over eighty separate channels may be tested in one revolution of the selector so that representative conductors in all cables entering an office are tested every forty or fifty minutes.

The conductors tested are selected from the layers directly under the cable sheath, since these will be among the first affected by intruding moisture. The arrangement of circuits is such that telephone service is not interfered with during the test.

Upon the appearance of a fault in the course of testing, the alarm notifies the test-board man and lights a lamp individual to the line affected. The test-board man immediately checks the insulation of the line indicated, and tries to locate the fault with his equipment. In due time a cable splicer is dispatched to the point determined by the test-board measurements to repair the defect.

The low-insulation testing apparatus thus plays its part in maintaining the cable in service. At times it detects slow leaks hours in advance of any other warning which may come as a result of impaired service as the cable becomes permeated with moisture. At such times, the repair process may be started just so many hours earlier, with a resulting reduction in the lost circuit time which is incidental to a fault, once it grows large enough. With a sudden and serious fault, the device supplements the warning of the transmission loss which results.

WRENCHES AND THEIR PART IN ACCIDENTS

Wrenches of all kinds including the monkey, Stilson, open end and S varieties often play important parts in accidents. The jaws of these wrenches should be inspected with special care, because sprung jaws prevent wrenches from taking a firm hold on nuts, with the result that they often slip off and cause serious injuries. In most cases it is impossible to restore the sprung jaws to the proper form, and therefore wrenches that are damaged in this way should be disposed of in such manner that they will not be put in service again either by oversight or intention.

Jaws are often sprung, handles are bent and other damage caused by slipping pipes over wrench handles to increase the leverage. There is seldom any advantage in adopting this practice provided that a wrench of suitable size and type is used in the first place.

A wrench is not a safe or proper substitute for a hammer and when it is used as a makeshift in this way the work is usually unsatisfactory, the workman's hands and fingers are likely to be injured and the wrench itself is often damaged. As a rule when a wrench is maltreated in this way, it simply means that the workman is unwilling to take the trouble to get a hammer and do the job right.

The wooden handles on monkey Stilson wrenches often become cracked or broken and if the men use them in this condition hand injuries are likely to result. It is best to provide new handles as soon as possible in all cases; but occasionally for light work, temporary repairs can be made by winding electrician's tape around the damaged wooden parts. Wire is sometimes used for this purpose but we do not recommend it because the ends are likely to protrude and cause injury to the workman's hands.—Travelers Standard.

THE FOREMAN CAN CONTROL ACCIDENTS

Injuries resulting from accidents occur far too often. Thousands of lives are lost and immeasurable suffering exists because of accidents. Billions of dollars are lost annually. You and all other purchasers, and the consuming public in general, pay these losses in the prices charged for food, clothing, shelter, and other necessities and luxuries of life. Research proves that 98 per cent of our accidents are preventable and that 88 per cent of them are due, not to unguarded machinery, but to supervisory conditions within control of the foreman. Accidents represent man-failure and the foreman is the one person in industry who knows how to control men. H. W. Heinrich in The Travelers' Standard.

SOME OLD TIMERS REMINISCE

Some amusing reminiscenses of old times came to light at a meeting of old timers in Chicago, according to Bell Telephone News. The group was made up of men not one of whom had less than

five stars on his service button and several of whom counted eight stars.

In those days practically all wire was strung from housetops—"open wire," as it was termed—underground cable being comparatively unknown then. From various quarters arose so much opposition, for some unknown reason, that men frequently restored the practice of "stealing wire." That is, if they did not have the tenant's permission, they'd "steal" the cable up without his knowledge.

Chuckling, his blue eyes twinkling behind his glasses, Paddy Crowley remembered how he was arrested three times for "stealing wire" because irate home owners, not realizing the necessity of stringing cable from their housetops, complained to the police. And, since Paddy had the law against him, his job would usually end up by riding off with the policeman.

In those days, it seemed, if a man had an order to put up a wire, that meant it was to go up without fail. The men adopted the attitude that "orders were orders" and schemed in every possible way to get the wire up. How they intended to get around one man's disapproval was brought out by another old-timer. He harked back to the way they laid their plans with all the furtiveness and secrecy of conspirators.

The foreman counseled one of his men, "You sneak up the side of the house real quietly, and we'll have that wire up before you can say 'jack rabbit.'"

"Well, is that so!" boomed the deep voice of a burly Irish policeman. "You come on with me." He bundled the whole bunch off in the patrol wagon, and there was no more "stealing of wire" that day.

In the great art of tree trimming, too, the same opposition of the public had to be battled with. Frederick Stobbart, who trimmed many a tree in his day, recalls many instances of stubborn wills which had to be conquered gradually by tact and patience.

On one particular occasion he came in contact with a man who "swore by all the gods that be" that no one was going to meddle with his pet trees.

After hearing that, Stobbart decided that any talk on tree trimming right then would be decidedly out of season. Calling all the tact he possessed to his command, he engaged the man in conversation, striking at his "weakness."

"Fine head of cattle you have there," he remarked. And that was all that was needed. From then on he listened to the whys, wherefores, and "whatfores" of Holsteins and Jerseys all day long, and although he had to stay for dinner and supper, he came away with the man's permission and his undying good will.

Discussion at these gatherings frequently swung around to the immense amount of wire that was strung from building to building back in the latter part of the nineteenth century. In the words of one old-timer, "Why, the wires were that thick on LaSalle Street to Madison, you couldn't see the sun shine. And like as not, if something went wrong, the woman manager of the office herself would climb up on top of the building and fix the wires.

One of the great sports of cable stringers of that time, recalled Mr. Stuart, was to race across a wire strung from roof to roof, by the popular hand-over-hand method. With nothing but quite a few feet between them and the ground—and perhaps eternity! But there was nothing to it, they declared.

Further light on the times was shed by George Henderson, who tells of the day when there were so few offices, and those scattered so widely, that it would take a half a day to get to one of them. In his job as repairman, Henderson remembers especially the occasion when he set out to fix some wires that had been burned out in a restaurant fire. The place was flooded, and a pair of rubber boots was needed. But not having any handy he used the first thing at hand, two chairs, to keep him high and dry. And they worked beautifully, until an unsuspected sewer hole lowered his dignity in quick fashion.

The company's early experiments with glass insulation and the famous Brooks oil cable came in for plenty of reminiscing, too. How when the new glass insulated cables were being hauled in wagons, the jarring shivered the glass into a million fragments! And how disappointing it was to those who had hoped that glass insulation would be especially valuable because of its non-leakage quality!

And how in the days of the Brooks cable, they'd be pumping oil into the pipe, and suddenly someone would cry, "Oh, there's the band!" How forgetting all about the oil, the whole crew would troop off to watch the parade, while the oil occasionally caught fire and burned merrily on.

(*Continued from page 29.*)

lators acting automatically with such a high degree of accuracy that the variation will not amount to more than 0.01 in a 1000.

When comparing first cost and maintenance of tubes and machines, it must be taken in consideration that one high frequency machine can provide carriers of the same frequency for a number of circuits not using the same pole line. In this manner two machines may furnish high frequency energy for six messages.

To produce six different carrier frequencies for three carrier conversations over the same circuit two high frequency machines are required only, while six sending tubes would be necessary to obtain the same result.

TELEPHUNNIES

A toll line was constructed some years ago connecting Antlers, Oklahoma, with Hugo, Oklahoma, and being the first long line brought into Antlers, conversation over such a long distance was considered something of an oddity by the natives.

When all the work was completed some of the telephone men were talking over the line testing transmission qualities. An Indian happened to walk in and he asked what was going on, whereupon one of the men explained that they were talking to Hugo.

"Uhmmm! Can't do that," he said, "Hugo too far."

"All right," was the answer, "We'll let you talk over it and see for yourself. To whom would you like to talk?"

"Choctaw Indian," was the reply.

In a short time a Choctaw was located on the streets of Hugo and he was brought up to the telephone and then the two Indians carried on a lengthy conversation. At the end of their talk the once doubting Indian handed the receiver back to one of the attendants and said, "Hmm! Damn thing learn talk Choctaw already."

* * *

A big Choctaw Indian walked into the plant room at Hugo one day while the battery was being charged and he saw the mercury arc rectifier operating. He stood looking at the light flashing and sizzling as though it were lightning for some time and then turned to the wire chief and queried, "Uhmmm! Catch him or make him?"

Corntossel (at the phone): "Hello! Hello! Kin you let me talk to my wife?"

Operator: "Number, please."

Corntossel: "Say, I ain't no Mormon, miss!"

Underground Cable Construction

This Is a Further Discussion of Underground Cable Construction and Manholes, Manhole Fixtures and Drainage of Manholes Are Discussed. Written by Ray Blain, Telephone Plant Engineer.

After the underground cable job has been engineered and the working plans completed; the grade arrangement of the conduit decided upon and plans for mixing the concrete arranged as described in the first part of this article the next thing to get under way is the manhole construction.

Manholes

Manholes can best be described as junction points in the underground duct system though to me manhole is a misnomer. I do not understand why they are not called junctions or some other appropriate name. They can be constructed of concrete or brick but the former is the more commonly used at

Fig. 6—Manhole form in place with reinforcement rods and cover

the present time for they are more easily and quickly constructed.

Concrete will stand great compression but does not have much power to resist bending force and as manhole walls are always subjected to certain stresses they should always be reinforced. Iron rods are used to reinforce square or hexagonal manholes and wire mesh or expanded metal for round ones. However, there is really no advantage of a round manhole and they are seldom if ever constructed for telephone purposes.

Good solid forms should always be built for concrete manholes and they should be braced thoroughly so that they will not bulge when the weight of the concrete presses against them. It is a good plan to use well matched lumber for the forms and take care to make all cracks tight so that the cement cannot seep through them. In manhole construction it is generally necessary to construct an outer wall for retaining the concrete except in locations where the earth is unusually firm and an accurate sized hole can be dug. The forms in place with frame and reinforcement rods for a square manhole are indicated in Fig. 6. Just before concrete is poured, the forms should be thoroughly soaked with water to prevent the dry lumber from absorbing moisture from the concrete.

There is on the market an iron manhole form that is set up in sections and bolted together. These forms in addition to being a big labor saver also do a better job and insure a standard uniform manhole throughout the exchange. Of course there may be cases due to some obstruction that a standard manhole cannot be used but where the system is carefully planned such instances are rare.

While concrete is being poured it should be thoroughly spaded from the inner wall. This consists of running a thin board or straight shovel down the side of the form to force all rocks from the surface which permits the cement and sand to lay next to the form and give a smooth solid inner wall to the manhole.

It is always a good plan where possible to pour manholes direct from the power mixer as indicated in Fig. 7 as with this arrangement considerable time and labor is saved.

The forms should not be removed from the manhole until the concrete has thoroughly set. The amount of time required for this will of course vary with the mixture used. A good practice is not to remove forms in less than 48 hours and it is much better to leave them in place three or four days or even longer if possible. Leaving forms in place for a longer period of time prevents a rapid evaporation of moisture from the surface of the concrete and permits it to harden better. If the forms must for any reason be removed after allowing the concrete to set only 48 hours then the concrete should be wet down twice daily until thoroughly hardened. The proper aging of concrete not only makes it harder but also prevents cracks which sometimes ruin a job.

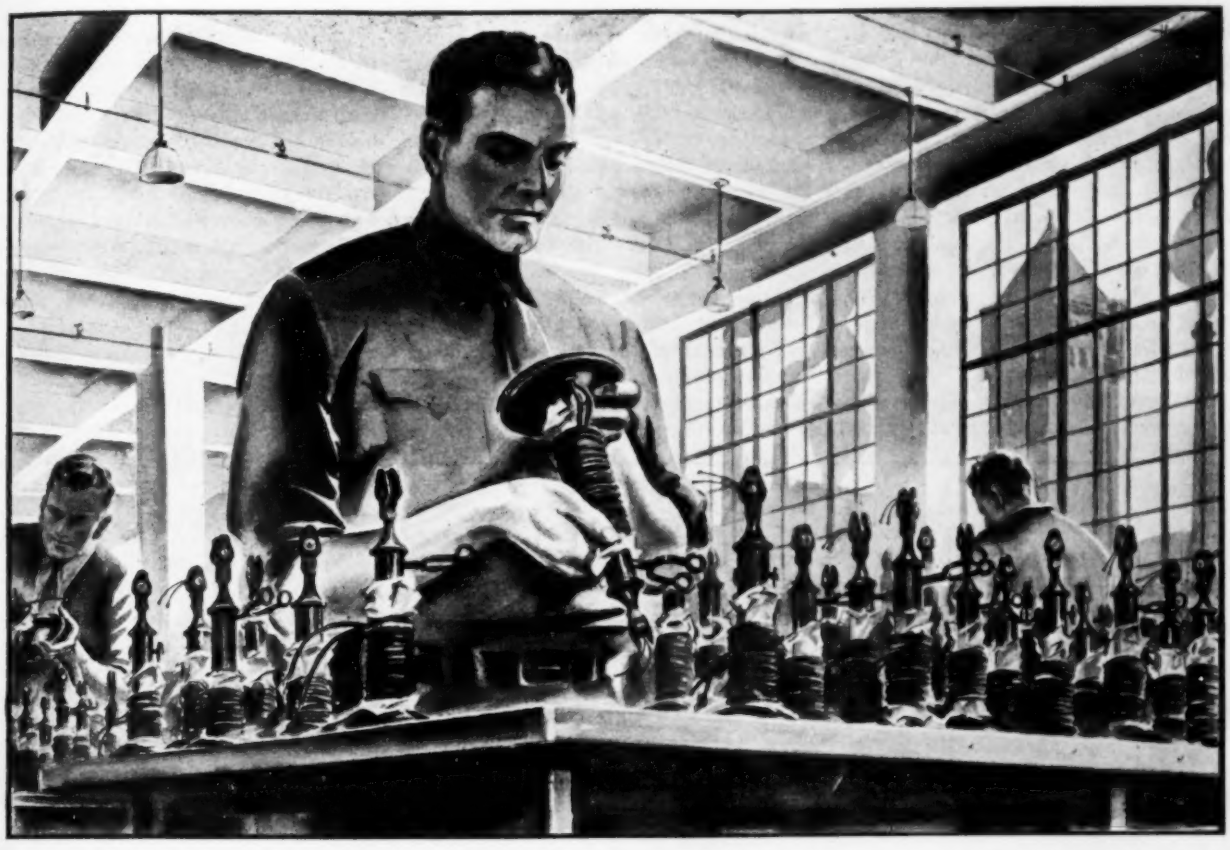
It is a very difficult task to give a hard and fast rule for the size of manholes. The number of ducts used and the amount of cable it will be necessary to run through each will be governing factors that must be considered in each location. A manhole should not be smaller than four feet long, three feet wide, and four feet deep. It will seldom be necessary to build them larger than eight feet long, five feet wide and six feet deep in an average exchange. I have never been able to determine the necessity of a large standard sized manhole on a lateral run where it is definitely known that there will be not more than one or possibly two small cables run through it. Then on the other extreme there is nothing more inconvenient or expensive than having a manhole crowded. If a careful study is made it is usually possible to estimate the space required in each location and design the manhole accordingly. It seems to be a good plan to have two standard sized manholes in each exchange, a large size for main conduit runs and a smaller size for lateral use.

Fig. 7—Pouring manhole direct from power mixer

Square manholes are of course the simplest to construct but they are far from being the most convenient for forming and splicing cables.

The common square manhole is indicated in Fig. 8. The first drawing shows the conduit banks leaving the manhole at the corners. With this design the pulling-in irons are placed direct in front of the duct which is good though has the disadvantage that duct rods cannot be shoved directly through the manhole but must be uncoupled in each case. Another disadvantage is that cable must be formed around square corners.

The other design shows the same square manhole but with the "Y" method of conduit approach with pulling-in irons located directly in the center on the four sides of the manhole. This design eliminates the disadvantage of the square bends to form cable aronud as with the corner conduits on cables going straight through the manhole. This design is not satisfactory in a location where a large number of cables will pass through the manhole as it is difficult to provide proper racking space for splices.



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Your telephone company is in a position to offer you the service which you have today because the Bell System is organized to meet your growing communication needs with increasing satisfaction and economy.

A more convenient design for a practical manhole is shown in Fig. 9 which is about the same as the regular square one but with the corners chopped off which makes the forming of cable easier. This is a good design and either it or one very similar is used in many localities. The first manhole in this drawing shows the duct bank directly in the center on each side. This arrangement has the disadvantage that the pulling-in irons must be placed below the conduit run. The other design in this drawing is about the same arrangement but with the "Y" conduit approach which provides better location of the pulling-in irons and cables are easier to rack properly. This design is considered best for all general purposes in the average exchange.

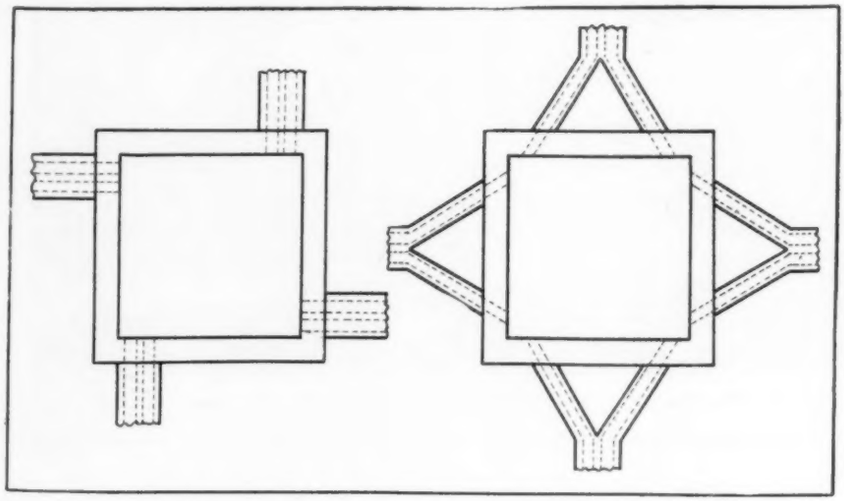

Fig. 8—Two designs of square manholes in common use

The corners are shaped so that even large cable can be formed easily for proper racking. Ducts on the opposite sides of the manhole should be lined for the purpose of rodding. The conduits for the cross runs should be either above or below the duct run of the straight-away in each manhole as this arrangement makes racking easier.

Manhole Fixtures

All manhole fixtures such as pulling-in irons, bolts for cable racks and steps or bolts for ladders should be set in the forms before the concrete is poured. It is generally advisable to equip all manholes over four feet deep with iron ladders or in some cases, iron steps set in the wall, will suffice. A ladder of some type permanently installed will in most cases prove cheaper in the long run than requiring each cable crew to carry two or more cumbersome wooden ladders. Ladders permanently installed in the proper location in manholes often prevents trouble as workmen are apt to use the racked splices as steps in getting in and out of manholes if they do not happen to have a ladder handy.

Extreme care should always be taken to provide adequate facilities so that all cables can be racked properly. All cables running through a manhole should be located on the racks in a manner which provides adequate space to splice or repair either cable without disturbing any of the others. I know of one case where the proper spacing was not observed and numerous cables were run through a manhole in a haphazard manner and it was necessary to cut slack in three of them before the one in trouble could be reached. This was not only expensive but caused a delay in clearing trouble on important telephones.

Pulling-in irons should be located so that the pull will be as near in a direct line with the duct as possible. In some types of manholes this may not be possible but if care is taken they can be placed near enough to a direct line that no trouble will be experienced.

Drainage of Manholes

When possible it is always best to drain manholes into a sanitary sewer. The danger of gas may be somewhat greater with this arrangement but it is not uncommon in any underground system so every precaution should always be taken before causing workmen to enter a manhole to make sure that it does not contain harmful gases. If sewer connections are not available then a hole should be left in the bottom to form a sump. This hole should be from five to eight inches in diameter and with an earth auger bore a hole straight down five feet or more. This hole should be filled with coarse gravel which in the average soil provides adequate drainage. The question of drainage is one to be controlled by local conditions and in some cases it may be even necessary to seal manholes and make them as near water tight as possible. I have known locations where manholes were virtually springs and it was necessary to keep pumps running continually while men were working in them to keep the splice above the water level.

Manhole Covers

All manholes should be equipped with a good, heavy, tight fitting cover. The frame for this cover should be set firmly on the manhole forms so that good binding will be obtained between it and the reinforcement in the concrete for it will be required to carry considerable strain if placed in a modern busy street. The top surface of the cover should be as near level with the finished surface of the street as possible. When manholes are placed in unpaved streets the paving grade should be obtained from the city engineers before the job is started.

All covers on the market today are good but I personally prefer the type that are locked in place with a key arrangement which keeps unauthorized or curious parties from opening the manhole. With the old fashioned type it is possible for a heavy loaded truck to pass over them rapidly in such a manner, to flip the lid off and leave a nice opening for an expensive lawsuit against the telephone company. I never like to hear a manhole cover chuckle when a loaded truck passes over it. This locking type is arranged with a catch on the inside that is operated with a bar arrangement inserted through a hole in the lid. This new type can well be considered when figuring the estimate for new work. Manhole covers are generally round although square ones can be obtained. Personally I prefer the square ones as they seem to provide more room and better light and air in the manhole. The only argument in favor of the round cover is perhaps that they are stronger than it is possible to build the square ones.

Laying Conduit

Extreme care should be taken in the laying of all conduit to make sure that it provides a smooth surface inside the

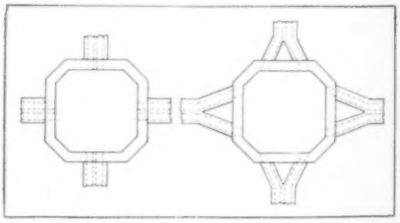

Fig. 9—Two designs of hexagonal manholes

duct and will not settle at the joints so as to pinch cable or prevent the entrance of duct rods in vacant ducts when it becomes necessary to pull in additional cables. Each section of the vitrified clay conduit is provided with holes in each end which are aligned with dowel pins to keep the inner surface walls of the ducts smooth and straight at the joints. The usual practice is to seal the joints first by wrapping them with a piece of paper or cloth from six to eight inches wide and then plastering the wrap with cement mortar one half to one inch

thick. If the earth is soft and there seems to be danger of the conduit settling in spots it is best to provide concrete footers under the joints at least. A better plan of construction of course is to provide a concrete base for the entire conduit line although this is more expensive and in the average soil is not necessary. A concrete cap is also in many cases placed on top of the conduit run which is a safeguard against mechanical injury.

Joints in the creosoted wood conduits

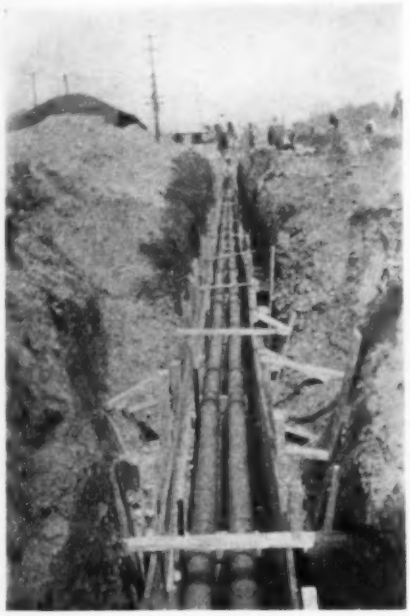

Fig. 10—Fibre conduit in place with forms ready for concrete

are usually sufficiently tight that they do not require reinforcement. Some prefer, however, to lay a creosoted plank under the run in certain soils and where likely to be subjected to mechanical injury a plank is likewise placed on top of the run.

Fibre conduit is generally laid in about the same manner as creosoted wood and in most cases the joints are sealed only with a tar paintlike substance.

Both creosoted wood and fibre ducts and in most cases clay duct is laid with broken joints. No two joints in parallel ducts come at exactly the same place. This arrangement greatly strengthens the duct line.

The use of fibre conduit on certain classes of work is thought to be very good but it is generally preferable to enclose it in an envelope of concrete. If this type conduit is to be installed in this manner it must be clamped together when multiple ducts are used and tightly staked down so that it will remain in place when the concrete is being poured. Clamps are supplied by the manufacturer of the conduit and iron stakes can be used wired together at the top as indicated in Fig. 10. This picture also shows a condition where the walls of the ditch cave badly and retaining walls or forms had to be provided for the concrete. This form though entailing some expense is much cheaper than using the large amount of concrete necessary to cover the duct in the wide ditch that must be dug in such soil.

A case where forms were not necessary is shown in Fig. 11 as the concrete was poured over the conduit and the natural walls of the ditch used to retain it.

On fairly large jobs of this kind considerable time and money can be saved by hauling a power mixer behind a tractor and hauling cement, sand and rock and if a hose is not handy water in a truck which keeps at the side of the mixer. With this arrangement concrete is mixed and poured where needed and all the clutter is kept out of the streets. One would be surprised at the large amount of conduit it is possible to cover in a day with this arrangement using only a small number of men. Concrete for conduit work should be mixed fairly wet so that it will run easily when dropped into the ditch and if more

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TYPE "J-3"—3 ft. 6 in. wide, 8 ft. 6 in. long, 5 ft. 6 in. headroom.

TYPE "J-4"—4 ft. wide, 8 ft., 8 ft. 6 in. or 9 ft. long and 5 ft. 6 in. headroom.

Penote Forms can also be supplied for Telephone Company manholes of other dimensions, as regards headroom, length and width.

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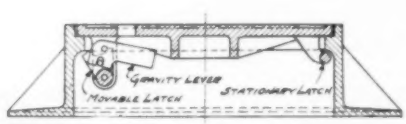

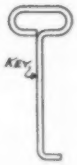

TO OPEN — Insert key, give quarter turn, lift to tilting position and roll aside.

FIGURE 1000

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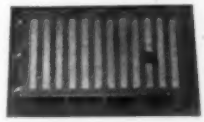

FIGURE 5000

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than is required is dropped at a certain point it can be easily run along the ditch with a long handle shovel to the place required.

In the laying of wrought iron conduit it is never necessary to provide any reinforcement at the joints as it is self supporting. It is, however, necessary to make sure that each joint is reamed well before connecting so that there will not be any burrs that could injure the lead when it is pulled in. To avoid corrosion and rust black iron pipe should always be painted well with some rust resisting paint before placing underground. Many prefer the use of galvanized or sheradized conduit to avoid this rust trouble which practice is thought to be the best plan.

Fig. 11—*Concrete envelope poured on fibre conduit without use of forms*

Lateral Runs

Lateral runs as generally referred to are smaller cables and fewer number of ducts branching off from the main conduit run to handle distribution. The main conduit runs can be likened to the trunk of a tree and the laterial runs to the branches. It is believed an ideal plan to make use of multiple duct vitrified clay conduit on all main runs and lateral runs to lateral manholes, to be fibre or creosoted wood and the runs from lateral manholes to buildings or up poles to terminals, to be wrought iron pipe.

It is common practice with the majority of the larger companies to take main conduit leads from the office out through the business sections of the city to the residential parts. Lateral runs carry the cable from here to each alley through risers to aerial cables to take care of the distribution. While this is considered by the majority as an ideal arrangement and generally used today it is doubtful that its use will be considered on new construction a few years hence.

While looking over a cable system in a village near a large city recently it was noted that a five pair cable was run underground to the basements of all the principal residences in each block. In each basement was installed a small inexpensive four pair cable terminal. This method seemed very expensive and out of the question at first thought but after consideration it was found to have many advantages that are also money savers.

There are not so many weak points in the line or chance of frequent trouble; no drops to replace; trees to trim or expensive substation protectors to maintain. As no part of the circuit from the exchange to the residence is exposed to electrical hazard the protection at the substation can be eliminated. The wiring inside the residence with this arrangement is a very simple one as it generally consists of only a short piece of house wire fished up from the basement inside a partition for a few feet.

It is believed that this small system is at least a decade ahead of the times and eventually others will realize its many advantages and larger systems will follow its practice.

English Telephone Terms

Uncle Sam's English is not the same as the King's English, American girls with the Disarmament Conference delegates in London have found when attempting to make telephone calls for the various members of Secretary Stimson's staff.

Recently a cable dispatch from press correspondents covering the London parley recounted the difficulties met by one of the American girl telephone operators in understanding her English cousin at the other end of the line. The report suggested that one of the French women secretaries, all of whom are expert linguists, be employed as an interpreter.

The occasion for the misunderstanding noted is that telephone operating practices and expressions used by telephone operators in the United States are different from those followed in Great Britain. Special operators are in attendance at the London and New York end of the trans-Atlantic radio-telephone service so that the regular telephone operators in Great Britain and America do not have an opportunity to speak to each other and thus do not learn at first hand of their different expressions.

When the American girl secretaries on the staff of the American delegation to the conference arrived in London they discovered, upon making their first call over a London telephone, that the English girls were "telephonists" and not "operators" and that they answered to the name of "exchange."

Confusion on the part of the American secretaries increased when the English "telephonist" said "you are through" which, translated into American, meant "you are connected" and not, as the Americans supposed, "your time is up, please deposit another nickel," or "will you please hang up, we will call you." They discovered also that a "central office" is an "exchange" in London and that the "Long Distance Office" is "Trunk Exchange."

Similarly the "operating room" in a central office is known as a "switchroom" in the exchange and when a line is "busy" the English "telephonist" says "line is engaged." A "do not answer" report becomes "there is no reply" and the "attended pay station" is designated a "call office." A call is "completed" in the United States but it "matures" in England.

When calls are "cancelled" or "uncompleted" they are termed "ineffective" by the British. "Information desk" would be "Enquiry desk" in the King's English and when in London making a "trunk call" (long distance) one "books a call," that is to say "files a call"; a practice incidentally, that is fast falling into disuse in these United States as more and more long distance calls are completed on a non-hang up basis.

The common American variety of "toll circuit," used to such a great extent on suburban calls, goes under the name of "trunk" in London and "trunk" in the U. S. A. is merely "junction" in England.

Telephone operators in America, and in most cases subscribers too, always "talk" over a telephone but the British have a habit of "speaking." Our operators "cut into" connection by pressing a key on the switchboard in front of them and their counterparts of the British Isles "enter a connection." "Charges" are made for telephone calls in America but "fees" are the order for such conveniences in England, and when a line is "out of order" in New York it is simply "not working" in London.

The Jubilee Jedge

Miss E. Hartman says that a negro subscriber in the Shreveport "Eight" Exchange had called the police station to report some trouble with the neighborhood children, and the attendant had requested her to call the Juvenile Judge. After getting a "don't answer" report, the negro again called the police station with her troubles, saying, "Ah cain't git dat Jubilee Jedge to answah."—Southern Telephone News.

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Treatment of Locust Pins for Protection Against Termites

By C. M. Tilley, General Superintendent Texas Creosoting Company, Orange, Texas.

Termite damage to pole lines and pole line equipment has assumed proportions undreamed of five or ten years ago. This may be due to the spread of the termite or to conditions of which we are not yet cognizant. Termites, as we all know, have been successfully stopped by the use of preservatives, the most successful being creosote oil.

At the present time, poles and cross arms are being treated and used against them successfully but as a usual thing, the pin which goes in the cross arm has been overlooked, partly because of its location and the fact that it was thought probably protected more or less by being on the treated cross arm and pole and therefore only a slight chance for the termite to get at it.

This belief has been found to be wrong. Termite damage to locust pins

Figure No. 1

in creosoted arms has reached such proportion that recently a utility, having a good deal of damage of this nature, began looking around for a remedy for this condition. (See Figure 1 showing locust pin badly damaged by termites.)

Insulator pins are made of several different kinds of wood. The one most commonly used for this purpose is locust. Locust is a very dense wood and it was not know just how it would treat, however, on the problem being put up to

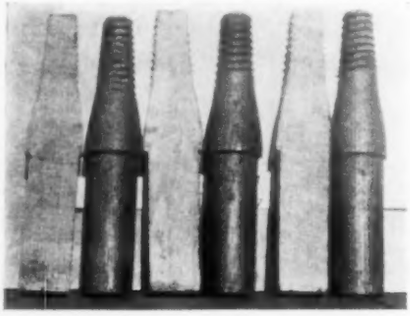


Figure No. 2

us, we immediately started out to find out just what we could do regarding the treatment of locust pins.

Knowing that in some localities it had been customary to dip pins in hot creosote, this was tried. The results were not good as shown in Figure 2. The penetration obtained by dipping six min-

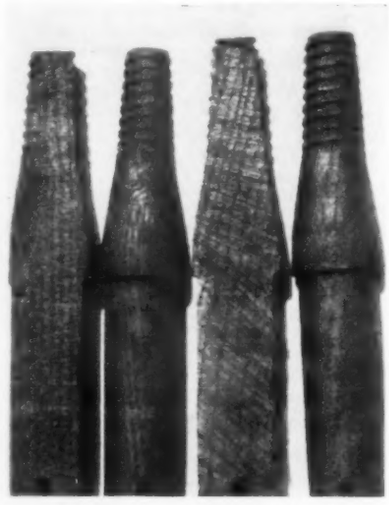


Figure No. 3

utes in hot oil was so negligible that it is very doubtful that the treatment would give the pins any added protection. Three dry locust pins were then put in the treating cylinder with 8-inch poles and on being removed from the cylinder were split in half. As can be seen from Figure 3. These pins had a comparatively dense treatment which went completely through the pin. This treatment, without a doubt, will adequately protect the pins against any termite attack which might occur and will make them as long lived as the pole and cross arm on which they are supported.

It has been the custom to treat pins made of some class of timber such as rock elm on account of their short life but it has never been thought necessary to treat locust pins on account of their natural long life. On account of the termite and his destructive habit, it will probably in the future be as necessary to treat locust pins for protection against them as it has been to treat the short-lived pin woods against decay.

Bell Telephone Company Improvements

Parrish, Ala.—Southern Bell Telephone & Telegraph Co., Atlanta, Ga., authorized by Interstate Commerce Commission, Washington, to acquire Parrish Telephone Co., R. C. Corr.

Louisville, Ky.—Southern Bell Telephone & Telegraph Co. announced plans for $1,000,000 telephone building, Chestnut Street, between Armour Place and Sixth Street, construction to begin in early spring; house city exchange, main exchange and long distance toll switchboard.

Baltimore, Md.—Chesapeake & Potomac Telephone Co. has $4,200,000 program under way for installing underground conduits and tables for telephone wires; remove 6,642 poles, 800 guys, 5,000 crossings, 113,000 feet small aerial cable, 270,000 feet old underground cable, 5,000 feet underground conduit, 680 feet submarine cable and 885 miles of wire now in service, includes new buildings, switchboards, about 8,000 new poles, 348,000 feet aerial cable, 260,000 feet underground cable, 20,000 feet underground conduit and 800 loading coils to be placed in cable and open wire lines.

Independence, Mo.—Southwestern Bell Telephone Co. erecting three-story addition to telephone buildings to be completed about March 1, 1930; installing modern equipment throughout building and lines in city; $245,000.

Kansas City, Mo.—Southwestern Bell Telephone Co. begin about December 1 razing present buildings, Oak Street and Whittier Place, for $1,000,000 first unit of 14-story telephone building; foundations to consist of 88 concrete caissons sunk 52 feet below surface of street; Hoit, Price & Barnes, architects, Telephone Building; I. R. Timlin, associate architect, Telephone Building, St. Louis.

Marshall, Mo.—Southwestern Bell Telephone Co., Telephone Building, St. Louis, completing plans for $20,000 telephone building addition, two story, brick.

West Plains, Mo.—Public Service Commission, Jefferson City, approved sale of West Plains Telephone Co. to Western Telephone Corp. of Missouri, 1101 Midland Building, Kansas City.

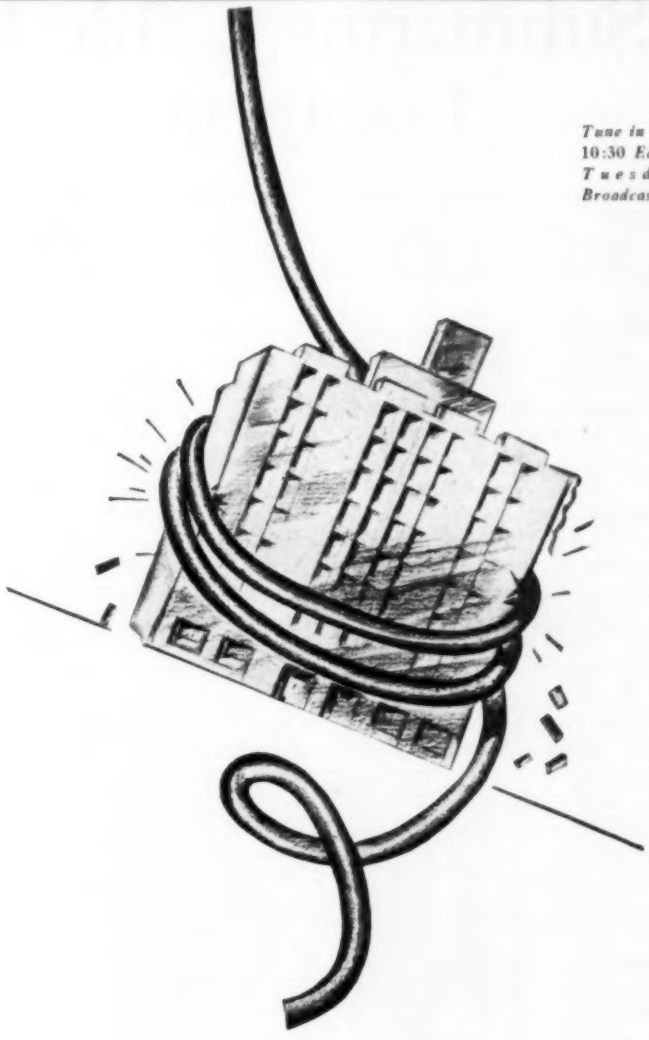
Nashville, Tenn.—Southern Bell Telephone & Telegraph Co., Third Avenue and Church Street, Nashville, and Atlanta, Ga., remodeling telephone building, under direction of engineering department; $10,000.

Telephone Engineer solicits well written technical articles for publication.

BACK COPIES WANTED

Copies of Telephone Engineer for July, 1929, and January, 1930, are desired immediately. Your subscription will be advanced 4 months for each copy sent us. And we shall appreciate the favor immeasurably, too.

Tune in on the Graybar Hour, 10 to 10:30 Eastern Standard Time every Tuesday night . . . Columbia Broadcasting System.



It can choke up an entire exchange . . . . .

A BIT of defective cable can throttle traffic on busy lines . . . annoy subscribers . . . throw a whole system in disorder . . .

"Unbroken service"—the watchword of the telephone industry—is synonymous with Western Electric lead-covered cable . . . the cable used in more than half the telephone lines in the world . . . not the cheapest cable, perhaps, but certainly the most economical in terms of service.

Here you have the experience of 61 years . . . the standards of the largest organization of cable experts in the world . . . the constant inspection and reinspection in manufacturing . . . the testing and re-testing . . . result; the "nearly-perfect" cable!

THE GRAYBAR TAG—SYMBOL OF DISTRIBUTION

GraybaR

Offices in 76 Principal Cities. Executive Offices: Graybar Bldg., 420 Lexington Ave., New York

Moving Submarine Cable Into New Location

Many Difficulties Present Themselves When Facing a Job of Moving Submarine Cable Into New Location. This is the Experience of a Crew Who Undertook Such a Job in San Francisco Bay.

Early last year the United States Government approved a project to dredge a ship channel of an ultimate width of eight hundred feet and depth of thirty-three feet to accommodate ocean going vessels to and from the new port of Oakland.

The new channel was to be dredged at about a forty-five-degree angle across the submarine cable area occupied by one of the cables of the Pacific Telephone Company, and four cables of the Western Union Company, three cables of the Postal Telegraph Company and the Southern Pacific Railway Company. The natural bottom of the bay that would be crossed by the channel ranged from twelve to eighteen feet below mean low-water level, which was just about fifteen or twenty feet too near the surface for comfort. Thus a very difficult problem developed over night.

Possible alternate submarine cable routes were investigated, but none proved feasible and it was decided that there was no practical route other than the existing one. Therefore, ways and means had to be devised of maintaining the existing route and at the same time of maintaining telephone communication between San Francisco and the cities comprising the East Bay area, as well as toll service to the north, east, and south.

After much deliberation, it was found that there was but one feasible method to employ, and that was to get the cables below the ultimate new channel depth. Accordingly, plans were formulated for dredging a cable channel and placing all the cables of all the interested utilities therein at a depth that would allow the ship channel to be dredged across them.

Naturally the cable channel must follow the straightest and shortest course between the landings on the Oakland shore and on Goat Island. Also, naturally, the Pacific Telephone and Telegraph Company's cables already occupied this location and therefore had to be moved to the north, clear of the route of the cable channel. This was the first step in the job.

When the course had been cleared of cables, the dredge Antioch was brought to the scene and in three months a channel was dug from the Southern Pacific Ferry Slips on the Oakland shore to deep water at a point about half way between Oakland and Goat Island. This channel is about 3300 feet in length, twenty feet wide at the bottom, about forty feet wide at the top, and from twenty to fifty feet in depth.

On completion of the trench commenced the real job of placing the cables therein. It was recognized that the trench would, in time, fill up and therefore the maximum future requirement of cable facilities must be placed in the trench immediately. Studies undertaken by the telephone company's engineers indicated that they should provide 3600 additional pairs of conductors, or six 600-pair steel armored submarine cables, in addition to the ten existing cables.

The tackle employed to raise the cables from the muddy bottom of San Francisco Bay

On October 22 of last year, with the winter storms about due, the construction force started the difficult job of placing the sixteen cables in the trench. The ten existing cables had to be moved with no service interruptions to the south to the line of the trench, in some places as much as five hundred feet.

The difficulties of the work were added to by the fact that years ago an old pier known as "Long Wharf" extended out into the bay in the area now occupied by the company's channel. The end of it fanned out like the fingers of a hand over several acres, and when it was removed about ten years ago there remained all the old broken piles protruding two to five feet above the bay floor. These piles would not permit the cables to be dragged to the south and made it necessary to lift them bodily over the area. Fig. 1 is a view of the tackle arrangement on the cable barge. The picture shows clearly how the cables were lifted entirely out of the water while they were being shifted.

When all the cables of all the interested utilities had been placed in the trench, a diver went down into the trench to make certain the job was successful. If one cable were out of the channel, or not down on the bottom for a few feet, it would surely be caught by the Government dredge, which would not only ruin that cable, but might pull all the cables out of the trench, to be caught on the next trip of the dredge.

"Hopper" type dredges were used by the Government in digging the ship channel. A hopper dredge might well be described as a big plow. It is, to all appearances, a regular steamer, but hanging underneath the steamer is a very formidable plow or scraper weighing many tons that can be lowered to a distance of fifty feet below the surface of the water. As the vessel moves forward under its own power the plow is lowered to a predetermined depth and up comes mud, sand, rocks and water to be deposited in huge tanks inside the vessel. Try to imagine what would happen to a submarine cable within reach of this plow.

Color Television Reported on Way

New York—A great advance in television has just been accomplished in the Bell Telephone Laboratories, making possible the transmission by wire and the reproduction of moving objects in their natural colors without the sacrifice of detail, it has just been announced here.

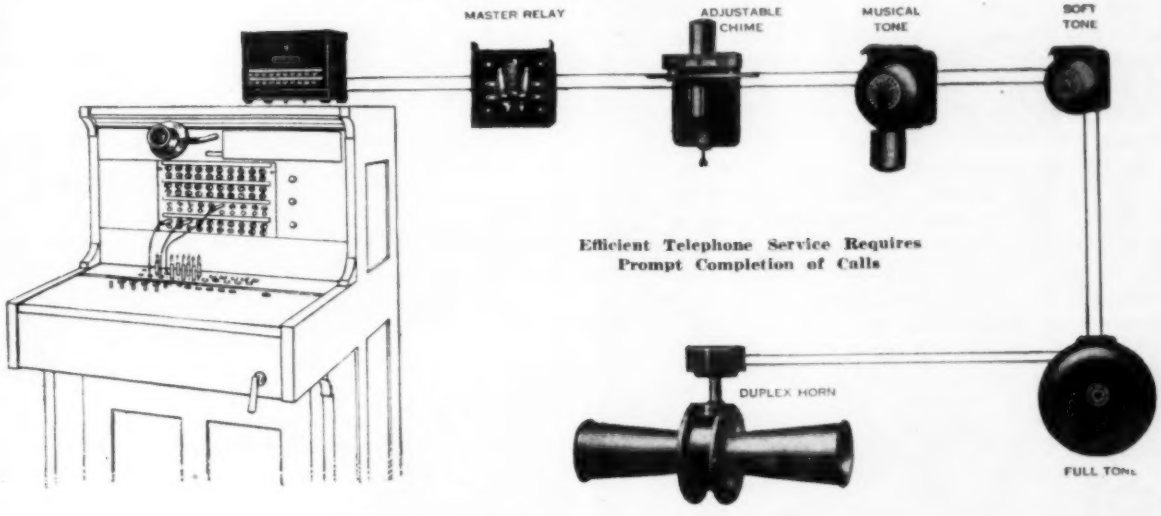
The color picture is restricted at present to the size of a postage stamp, but eventually, it was said at the laboratories, it will be possible to project on a much larger screen.

Dr. Herbert E. Ives, who has supervised the work of television says the "outstanding contributions that have made the present achievement possible are a new photoelectric cell, new gas cells for reproducing the image, and the equipment associated directly with them.

"To render the correct tone of colored objects, it was necessary to obtain photoelectric cells which—like the modern orthochromatic or panchromatic plate—would be sensitive throughout the visible spectrum. This requirement has been satisfactorily met."

SIGNAL CODE CALLING SYSTEMS

Bell Telephone Companies Install and Maintain This System on a Rental Basis



Efficient Telephone Service Requires Prompt Completion of Calls

The *Signal Engineering* Code Calling System Automatically pages individuals throughout buildings and plants.

SIGNAL
ENGINEERING & MFG. CO.
152 WEST 14TH STREET, NEW YORK

Complete line of Signals to suit any noise condition or individual requirements.

Branches: Boston, Detroit, Seattle, Chicago, Los Angeles, San Francisco

Get EVER-PROTECT aid in your construction.

EVER-PROTECT has proved practical and profitable in making many hundreds of cable installations underground without a conduit. It protects cable against storm damage, corrosion, chemical action, electrolysis and abrasion.

In liquid form EVER-PROTECT is great for overhead work, protecting your cable and messengers against chemical action and other destructive influences.

Ask your nearest jobber for complete details.

National Cable Compound Co.
Incorporated
MITCHELL - - IND.

Note Protection at Corners

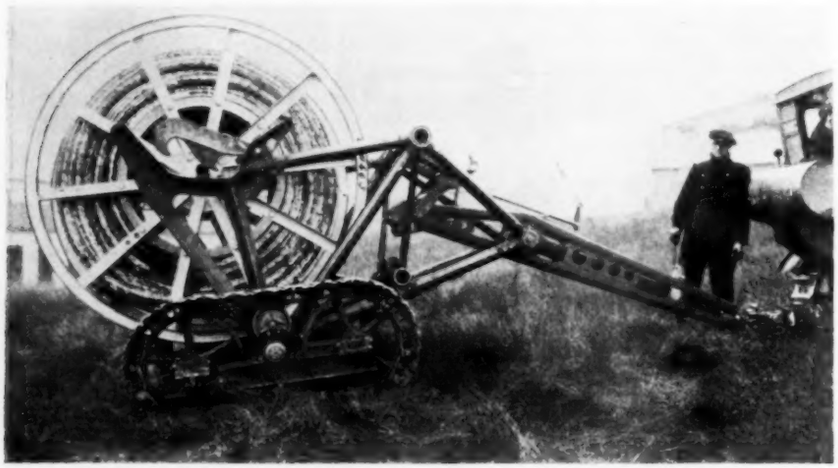
Blake Insulated Staples
Trade Mark

Unequalled for telephone and bell wiring. The fiber insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for samples.

Blake Signal & Mfg. Co.
BOSTON, MASS.

New Cable Reel Trailer Appears

To those in the public utilities field Utilities Supply Company, Clintonville, Wisconsin, announces the new A. T. and T. traction loading cable reel trailer, which has just been put on the market. This trailer, weighing about three tons, is of capacity to handle cable reels exceeding ten tons weight. It has the added advantages of being easily and safely handled by two men; by reading adaptability in "spotting" on the highway or after hauling over rough or soft dirt into which the ordinary wheel and axle type would sink into the ground. Roughest ground and even ditches have no terrors for the traction loading trailer. For toll or long line construction it is particularly well adapted in that the increased length of cable which can be carried reduces the number of splicing processes entailed, materially cutting the cost of that item.



A. T. & T. traction loading cable reel

The framework consists of two trapeziums of 4" O.D. special alloy heat-treated steel tubing electrically welded; each trapezium is braced by diagonal cross tube of same specification. The rear side of the trapezium consists of an inverted triangular pedestal of one-half inch electric cast steel from which extend the horns of a saddle in which one end of the reel supporting axle rests. Attached to the forward horn is a grab hook designed to clutch the cable axle when loading or unloading, thereby preventing rolling momentum in the reel as its axle rolls into or out of the saddle.

The loading mechanism consists of a combination of two levers of the first class. The first lever consists of the truss form, telescopic tongue which is pivoted on the front angle of the frame and is jointed near the rear end which again is attached to the rear upper angle of the frame; this lever is, therefore, a jacknifing mechanism at the jointed angle. The power, which need be no more than a ton and one-half ton truck or tractor for a ten tons cable reel load, is transmitted through this lever to a second one consisting of the frame with the fulcrum in the crawler axle. The jointed mechanism of the tongue swings around its pivot, lifting the load, bringing it forward of the center of the crawler axle. In this way a nice balance of load is obtained.

Safety devices consist in an automatic lock on the tongue jacknifing joint, a collar, on the cable-reel axle to prevent sideswiping, and of jacks attaching to lugs in the rear member of the pedestal to prevent the cable reel dropping to the ground when the driving power is detached. A short load-arm lever breaks the tongue joint when occasion arises for lowering the reel saddle.

The carrier rides on an endless track running over dual solid tired wheels membered by an axle with 96" outside length. The tongue is hitched to the propulsive power by a specially designed pintle hook.

Tar Distillers Seek Wood Preservation

London.—The Association of Tar Distillers recently formed a new commercial research society—the Wood Preserving Association—for the prevention of wastage of wood caused by the neglect to use proper means of preservation against rot and the attacks of insects. Various new protective processes will be investigated. The inaugural meeting of the association received widespread support and was attended by representatives of various government departments, railway companies, engineering and timber trades, architects and chemical manufacturers.

Made Vice-President

W. Earle Pashley, advertising manager of the C. F. Pease Company, 813 North Franklin street, Chicago, Illinois, has been appointed assistant sales manager and second vice-president. Simultaneous with that appointment Mr. Pashley was elected to the board of directors and in addition to his new responsibilities will continue in charge of advertising and all promotional activities of the company.

Selects Stromberg-Carlson Toll Board

The Stromberg-Carlson Telephone Manufacturing Company of Rochester, New York, has just announced that an order for a six-position toll board for Weldon, N. C. has been placed with it by the Carolina Telephone and Telegraph Company at Tarboro, N. C.

DEPENDABILITY . . . long life . . . economical operating and maintenance costs are the reasons why the use of Exides is increasing in P.B.X. service.

EXIDE-IRONCLAD P.B.X. BATTERIES

Exide - Ironclad Battery, type B1-5, especially designed and constructed for P.B.X. service.

Exide
BATTERIES
THE ELECTRIC STORAGE BATTERY CO., PHILADELPHIA

The "STEWART" Cable Tester

Locates shorts, crosses, grounds and wet spots to an inch. Will often save its cost on one case of cable trouble.

Order a "STEWART" Cable Tester and be sure you are going to locate your next case of cable trouble quickly.

Any telephone man can use it. Not an instrument that only an expert can use.

Equipped with two vibrators and an indicating lamp. Write for circular.

Sent on 10 days' trial.

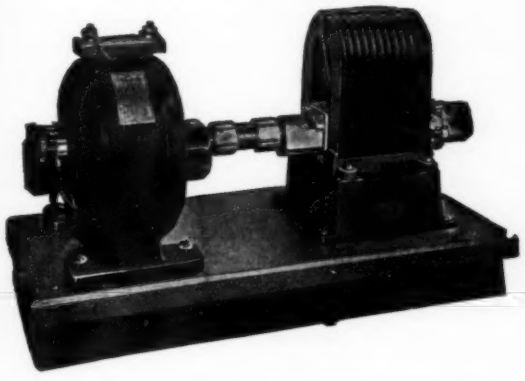
Also, Test Sets, Test Cabinets and Detecto-Meters.

STEWART BROTHERS
OTTAWA, ILLINOIS

HOLTZER-CABOT

Magneto - Ringing - Motor - Generators

Maintain Better Service



Maintaining an efficient, economical, carefree ringing service need not be a problem—but it does require good judgment in selecting your equipment.

Install Holtzer-Cabot Magneto Ringing Motor Generators. These units will enable you to dispense with battery maintenance and constant service diligence. Can be supplied for any voltage or special current.

We invite correspondence. Complete data on request.

HOLTZER - CABOT ELECTRIC CO.

125 Amory Street, Boston, Mass.

6161 So. State Street, Chicago, Ill.

KESTER FLUX-CORE SOLDER
FLUX IN POCKETS
SOLDER WALL
Ready to Use
Needs only Heat
KESTER SOLDER
SIMPLE
Soldering success in one operation—all you need is heat and Kester—the flux is in the solder. Eliminate waste caused by oxidized connections and loosened contacts. For simpler, surer soldering use Acid-Core for heavy duty and Rosin-Core for delicate work. Our experimental and research department is always at your service. Write for booklet—"Facts on Soldering."
From all Jobbers.
Kester Solder Co., 4218 Wrightwood Ave., Chicago, Ill.
Established 1899—Formerly Chicago Solder Co.
KESTER
FLUX-CORE
SOLDER
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METAL MENDER
RADIO SOLDER

TELERING

For Central Office and PBX Ringing

ONE REED!

ONE CONTACT!

IDEAL WAVE FORM

ORDER ONE ON TRIAL.

NO OBLIGATION TO KEEP.

Fully Guaranteed

Converts 60 Cycle Lighting Current to 20 Cycle Ringing Current.

POSITIVELY NO RADIO INTERFERENCE

Very low current consumption.

Model EX-3 has been proven the ideal ringing machine by hundreds of satisfied users.

Price $44.00—F. O. B. Elyria

IT PAYS FOR ITSELF

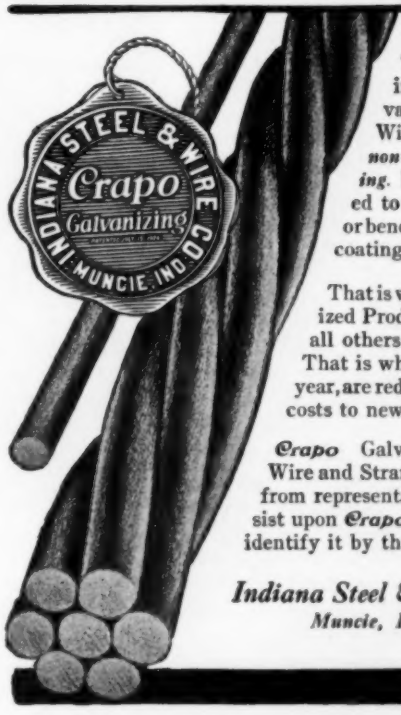
Sold by Leading Telephone Distributors

Telkor, Inc., Elyria, Ohio

(Write for booklet)

Crapo

GALVANIZED PRODUCTS



The pure zinc coating on *Crapo* Galvanized Telephone Wire and Strand is *non-peeling, non-cracking*. Even when subjected to splicing, twisting or bending, this protective coating remains uninjured.

That is why *Crapo* Galvanized Products are outlasting all others in actual service. That is why users, year after year, are reducing maintenance costs to new low levels....

Crapo Galvanized Telephone Wire and Strand can be obtained from representative Jobbers. Insist upon *Crapo* quality! You can identify it by the *Crapo* Tag....

Indiana Steel & Wire Co.,

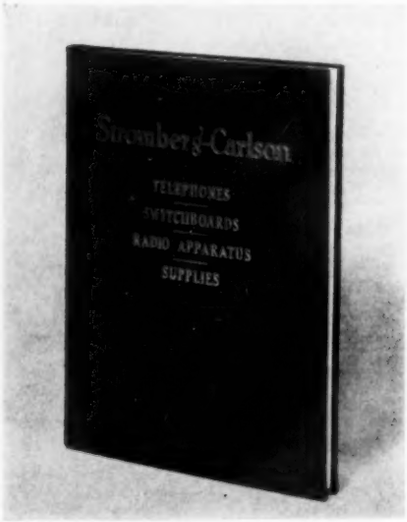
Muncie, Indiana

With the Manufacturers

Stromberg-Carlson Issues 1930 General Catalog

In line with its policy of issuing yearly a general catalog of all the products it manufactures, the Stromberg-Carlson Telephone Mfg. Company of Rochester, New York, has prepared and is distributing among telephone operating companies, its 1930 Catalog.

A greater portion of the book is devoted to telephones, switchboards and parts made by Stromberg-Carlson. Fifty pages are devoted to supplies manufactured by other companies and distributed to the telephone trade through the Stromberg-Carlson organization.



New Stromberg-Carlson general catalog

The book is divided up into nine sections.

Seventy pages are devoted to switchboard parts including coils, cables, blanks, cords, jacks, etc.

Forty-six pages are given over to Switchboards including magneto, private branch exchange, multiple, toll, chief operator, wire chief and junior multiple.

A section of twenty pages is devoted to switchboard accessories and includes main distributing frames, storage batteries, battery charging equipment, exchange ringing equipment, vibrating and rotating converters and many other accessories.

Telephones including Inter-Comm systems and accessories take up thirty-two pages. Every type of telephone manufactured by the Stromberg-Carlson company is listed in this section.

General supplies for construction and maintainance purposes are listed on forty-nine pages. These include products manufactured by other companies and distributed by Stromberg-Carlson.

A feature section of 18 pages is devoted to piece part plates. Individual parts used to form various pieces of apparatus are laid out separately, but in their relative positions and labeled with factory piece numbers. This makes it easy for the customer, who may need a minor repair part, to select a piece identical to the one needing replacement.

Each article listed in the catalog has been thoroughly tested in laboratories which assures operating companies that they are getting apparatus that will give them the best of service.

All necessary data such as size, weight, etc., is given about the listed articles. The book is highly illustrated in order to make it easy for the customer to know that the articles selected will fit in with his equipment.

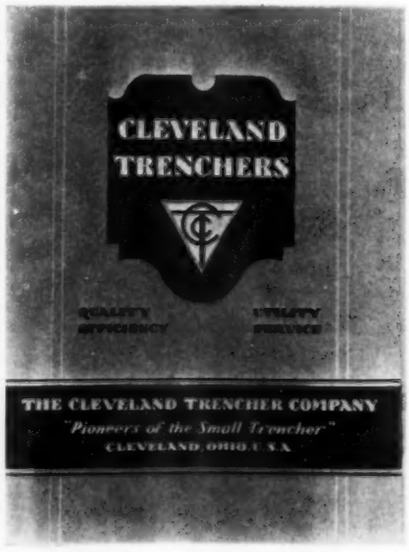
Cleveland Trencher Co. Issues New Catalog

The illustration herewith shows the latest catalog which has been issued by the Cleveland Trencher Company of Cleveland, Ohio.

From a physical point of view this book is very attractive. The covers are red and black and the inside pages are fully illustrated. The size of the book is 8½ by 11, convenient for any files.

This Cleveland Trencher Company catalog No. 10 is complete covering all machines and products manufactured and sold by this company.

For many years, The Cleveland Trencher Company has been manufacturing machines and equipment of interest to and used by gas companies, telephone companies, electric light and power companies, municipalities and federal and state government and general contractors.



Cleveland Trencher issues new catalog

The products covered in the catalog are Cleveland Baby Digger, Cleveland Pioneer, Cleveland Tamper-Back-Filler, Cleveland Curb Digger, Cleveland Trailers, and Penote Sectional Steel Manhole Forms and accessories for underground conduit work.

The book has been very carefully prepared covering all phases of the machines and equipment produced by The Cleveland Trencher Company. One very attractive feature of this catalog is the profusion of illustrations which show exceptionally well not only the construction and technical details of the machines and products but also the application of the different machines. These illustrations are all actual photographs made out in the field. This book also includes full specifications of all Cleveland Trencher machines and products.

If you are interested in securing a copy you can do so by addressing us or writing directly to the Cleveland Trencher Company at 20100 St. Clair avenue, Cleveland, Ohio.

New Central Office Telephone Equipment Installed at La Grange, Indiana

Saturday, January 18th, the LaGrange County Telephone Company cut over to its new Kellogg Common Battery equipment just installed in the newly acquired telephone building at its main exchange in LaGrange, Indiana.

The work of installing the equipment in the telephone building had been in progress for six weeks by Chief Installer C. M. Robinson of the Kellogg Switchboard and Supply Company of Chicago.

The new equipment consists of a three position Kellogg board wired and equipped to suit the particular needs of LaGrange. There is one toll position equipped with ten pairs of toll cords, two pairs of universal cords for pay station lines and five hospital cords. Each of the two local positions has seventeen pairs of Kellogg full feature cords. These cords provide the most modern type of service possible such as line lamp recall, instantaneous disconnect, automatic ringing, etc.

For local service there are two hundred common battery lines. The rural service is handled by eighty common battery rural lines, provided with reversing jacks for ringing any one of the ten bells on each of the lines. There are ten common battery free toll lines, ten pay station lines, twenty drop ended toll lines and five toll recording trunks.

The ringing is five frequency harmonic on all local lines and ten party harmonic ringing on the rural lines.

The harmonic ringing equipment is operated by an interrupter driven by a 110-volt A-C motor or a 40-volt D. C. motor. This apparatus also provides "out of order" tone for the hospital cords. The equipment is so arranged

that should the 110 volt A-C current fail, the interrupter is instantaneously switched to the forty volt D. C. motor.

The main exchange battery consists of 20 cells. The rest of the battery equipment consists of eleven cells of noise killing battery. Charging is done by a twelve ampere tungar rectifier, automatically controlled.

The new central station equipment is but a part of the complete rehabilitation program. The outside plant has been, to a great extent, rebuilt with modern cable construction.

The LaGrange County Telephone Company was acquired in September, 1928 by the Interstate Telephone and Telegraph Company. There are nine exchanges located in the following towns: Ashley, Howe, Mongo, Rome City, South Milford, Shipshewana, Stroh, Wolcottville and LaGrange.

Extensive improvement throughout this territory which includes 2,300 subscribers has been climaxed by equipping the main or central exchange at LaGrange with this modern telephone building and the very highest type of telephone equipment.

These improvements have been made with the idea in mind that it is good business to furnish the public with as high a type of telephone service as it is humanly possible to give.

Officers of the LaGrange County Telephone Company are: Pierre F. Goodrich, president; Sam Tomlinson, vice-president; R. W. Frost, secretary and treasurer and P. J. Maloney, district manager.

W. B. Stants is the local superintendent. Myron Teal and Miss Leona Williams are in charge of the commercial work and Miss Eva Philbreck is chief operator.

Common Battery Oak Residence Type Wall Sets

Kellogg F-729-SA straight line ringers $5.75

Kellogg F-729-HA or HB harmonic or syncromonic ringers $6.25

Leich Elec. Co. 29-A induction coil type, straight line $4.50

Leich Elec. Co. 29-C harmonic or syncromonic $5.00

Buckeye Telephone & Supply Co.
COLUMBUS, OHIO

Reconstructed Equipment

Western Electric Co. No. 317 A. H. type 3-bar 1000-1600 or 2500 ohm Bdg. compact type wall telephones @	$ 9.25
Am. Elec. or Andrae 5-bar Bdg. hand Generators complete @	2.35
Am. Elec. or Andrae 4-bar Bdg. hand Gen. complete @	1.65
Automatic Permanent Magnet receivers complete with cord and New Western Elec. Shells @	1.10
Stromberg Carlson No. 599 type 4-bar 1000 or 1600 Bdg. compacts	6.90
Kellogg No. 2696 type 4-bar 1000 or 1600 ohm Bdg. compacts @	8.50
Monarch 4-bar 1000 or 1600 ohm Bdg. compacts @	7.25
Kellogg magneto desk sets with New cabinet inside connection signal set 3-bar 1000 or 1600 ohm $10.00—4-bar $10.75—5-bar @	11.50
Chicago Tel. 4-bar 1000 or 1600 ohm Bdg. compacts with Kellogg transmitters $7.25—5-bar @	8.00
Stromberg-Carlson No. 599 type 5-bar 1600 ohm Bdg. compacts @	9.50
Kellogg No. 79 or W. Elec. No. 46 Common battery Ind. Coils @	.50
Kellogg No. 97 C. B. desk sets complete with No. 404 or 259 Straight line steel signal sets @	7.00
Kellogg Transmitters complete @ $1.10 —Western Elec. @	1.25
Western Elec. No. 143 Receivers complete with cords @	1.25
Reliable Elec. No. 27 One Amp. Wood Fuses, same as Cook No. A7. Distance between shoulders 4¾ inches. Per 100	3.50

Write for Our Bulletin
REBUILT ELECTRIC EQUIPMENT CO. Not Inc.
1940 W. 21st St., Chicago

FOR SALE

TELEPHONE BUSINESS, North Carolina. Consisting of exchanges in three growing towns. New automatic system installed. Increasing business. Price $75,000.00. National Brokerage Company, Omaha, Nebr.

Send for free sample and prices on
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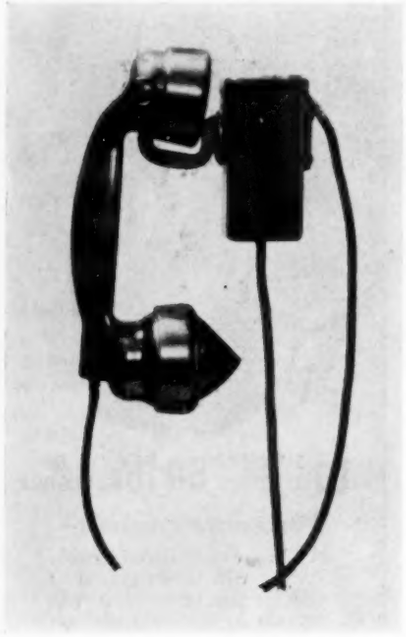
Stromberg - Carlson Announces New Hookswitch Box Telephone

Anticipating the trend of modern homes and offices toward compactness of furnishings, Stromberg-Carlson engineers have for some time been developing a small handset telephone to fit into this picture of compactness.

This set, known as the No. 1181 hookswitch box handset, has just been placed on the market by the Stromberg-Carlson Company.

This telephone is unequaled for convenient operation as it can be mounted in any part of a room or on any piece of furniture without consuming much space.

The new No. 1181 has done away with many inconveniences. It makes an ideal bedroom extension telephone as it mounts right at the bedside, either on the bed



New Stromberg-Carlson Hookswitch Box Handset

itself or on the wall, handy to the bed.

For the business man, the No. 1181 is even more desirable than the cradle type handset as it conserves space on his desk and is permanently mounted and cannot be knocked to the floor. The set may be hung at the end, side or in the alcove of the desk.

These and many other uses make the hookswitch set one of the most practical ever produced.

The No. 1181 consists of the No. 41 type of hookswitch with a specially designed hook to hold the standard Stromberg-Carlson handset.

The wiring connections and hookswitch contacts are housed in a small pressed metal box finished in black enamel and measuring only 2¾"x2⅛"x4".

The handset is the same as in the No. 1177 cradle type telephone and uses silicon steel coil cores to give increased efficiency and a chrome-alloy steel magnet to insure a definite and permanent magnetic field. The magnet and cores are held firmly in place by means of two clamps so that there is no chance for any changing of distances between pole pieces and diaphragm clamping surfaces. The complete unit may be removed from the case by unscrewing the ear cap.

The coils are of the layer built type, wound with enamel wire and impregnated with wax to meet all climate conditions. A special carbon cup assembly maintains definite resistances for all positions.

The transmitter uses the standard Stromberg-Carlson button. The diaphragm is duralumin, a material especially adapted for this kind of work. The thickness of both diaphragm and dampening springs are selected for tone quality as well as transmission efficiency. Like the receiver, the transmitter is easily removed by unscrewing the ring holding the mouthpiece.

The mouthpiece is of a special construction designed to reflect the greatest possible amount of speech energy to the diaphragm.

The handle is designed and made of selected material especially to avoid having vibration in the receiver transmitted to the transmitter. With this accomplished the tendency to howl, due to acoustic coupling, is overcome, which makes it possible to use the "Booster Circuit."

The cords used on the No. 1181 are a No. 3-C-B 4 foot Brown Duratex Handset Cord and a No. D-3-C 6 foot Brown Duratex Desk Set Cord.

This set may be connected with any desk set box that is designed for use with a Stromberg-Carlson desk stand or cradle type telephone using the "Booster Circuit."

Stromberg-Carlson Declares Extra Dividend

An extra dividend of 12½ cents a share has been declared on the common stock of the Stromberg-Carlson Telephone Manufacturing Company and will be mailed this week to stockholders, together with the regular quarterly dividend of 25 cents a share. Last year the company paid two extra dividends, one in the first and one in the final quarter.

Business of the company is at the highest volume in its history, 1929 breaking all records, and 1930 starting off at increased volume.

FOR SALE

36 hundred feet (4 reels) new 12 pair rubber covered emergency storm cable, jacks attached .....7 cents per foot

Samples on request.

Also new bakelite mouthpieces for Western Electric transmitters, ...$5.00 per 100

Also new 3 conductor brown desk stand cords, spade and spade, metal stays, 5 feet six inches long .....$17.00 per 100

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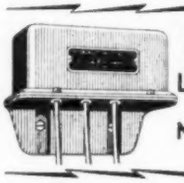

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